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AUTHOR INDEX

Abramson, H. A. 35
Bartley, S. Howard 157
Breskin, Stephen 41, 239
Clark, Edward T. 13, 185
Dey, Mukul K. 171
Doll, Richard E. 231
Dreistadt, Roy 123
du Mas Frank M. 225
Eisenman, Russell 147
Engel, Gerald 243
Enzie, Russell F. 107
Gettner, H. H. 35
Gorman, Bernard 239
Gruber, Ronald P. 257, 267
Gunderson, E. K. Eric 231
Harkless, Richard 253
Harley, R. N. 87
Harrison, Albert A. 163
Henderson, Norman D. 19
Hochman, Sidney H. 239
Jaffe, Joseph 41
Karsh, Robert 73
Kingery, Martha 137
Kirtley, Donald 253
Levita, Eric 45
Ludwig, D. 217
Mace, Kenneth C. 107
Meltzer, H. 217
Misiak, Henry 45
Monty, Richard 73
Mullozzi, Anthony D., Jr. 177
Ozehosky, Richard J. 185
Powell, Carroll E. 87
Propper, Martin M. 13
Riklan, Manuel 45
Roberge, James J. 53
Rolo, A. 35
Rosenzweig, Saul 59
Schludermann, Eduard 205, 217
Schludermann, Shirin 205, 217
Shaver, James P. 3
Sherman, Roger 227
Shipley, Robert E. 87
Simkins, Lawrence 137
Taub, Harvey A. 73
Uhes, Michael J. 3
Uyeno, Edward T. 271
Zajonc, Robert B. 163

TABLE OF CONTENTS

Dogmatism and divergent-convergent abilities 3
By Michael J. Uhes and James P. Shaver

Alienation: Another dimension of underachievement 13
By Martin M. Propper and Edward T. Clark

Behavioral reactions of Wistar rats to conditioned fear stimuli, novelty, and noxious stimulation 19
By Norman D. Henderson

Lysergic Acid Diethylamide (LSD 25): XXXIX. The effect of high temperatures on stability 35
By H. H. Gettner, A. Rolo, and H. A. Abramson

On the use of parametric statistical techniques to assess the on-off characteristics of speech 41
By Stephen Breskin and Joseph Jaffe

Critical flicker frequency and integrative functions in Parkinsonism . . 45
By Manuel Riklan, Eric Levita, and Henry Misiak

The effect of reversal of premises on children's deductive reasoning ability . 53
By James J. Roberge

E. G. Boring and the *Zeitgeist: Eruditione gesta beavit* 59
By Saul Rosenzweig

Effects of knowledge of results and method of payoff on keeping-track performance 73
By Robert Karsh, Richard A. Monty, and Harvey A. Taub

Alteration of mood via music: A study of the vectoring effect 81
By Leo Shatin

A method and model for automated assessment of human judgment . . 87
By Robert E. Shipley, Carroll E. Powell, and R. N. Harley

Dissonance *versus* contrast in an ego-involved situation with disconfirmed expectancies 107
By Kenneth C. Mace and Russell F. Enzie

The relationship of figural after-effects and geometrical illusions to successive and simultaneous contrasts 123
By Roy Dreistadt

Effects of stimulus duration and reinforcement schedules on self-reinforcement 137
By Lawrence Simkins and Martha Kingery

Birth order, sex, self-esteem, and prejudice against the physically disabled . 147
By Russell Eisenman

The homeostatic and comfort perceptual systems 157
By S. Howard Bartley

The effects of frequency and duration of exposure on response competition and affective ratings 163
By Albert A. Harrison and Robert B. Zajonc

Influence of information feedback on paired-associate learning 171
By Mukul K. Dey

Auditory and illumination effects on visual closure as predicted from brain blood-shift theory 177
By Anthony D. Mullozzi, Jr.

Children's self-concept and kindergarten achievement 185
By Richard J. Ozehosky and Edward T. Clark

Conceptual frames of parental attitudes of fathers 193
By Shirin Schludermann and Eduard Schludermann

Conceptualization of maternal behavior 205
By Shirin Schludermann and Eduard Schludermann

Community differences in positive mental health of younger workers . . . 217
By H. Meltzer and D. Ludwig

Periflash 225
By Frank M. du Mas

Culture and strategic choice 227
By Roger Sherman

The relative importance of selected behavioral characteristics of group members in an extreme environment 231
By Richard E. Doll and E. K. Eric Gunderson

Nonverbal rigidity and perseveration 239
By Stephen Breskin, Bernard S. Gorman, and Sidney H. Hochman

Comparison between Americans living in Israel and those who returned to America: Part II, Israeli background 243
By Gerald Engel

Student political activity in relation to personal and social adjustment . . . 253
By Donald Kirtley and Richard Harkless

Stimulus generalization following multidimensional stimulus training *vs.* unidimensional stimulus training 257
By Ronald P. Gruber

Discrimination, generalization, and awareness in verbal operant conditioning 263
By Ronald P. Gruber

Effects of Lysergic Acid Diethylamide on the maternal behavior of the rat . 271
By Edward T. Uyeno

NEWS NOTE 275

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3 & 4. A study of natio-racial mental differences—N. D. M. Hirsch
5. A psychological study of juvenile delinquency by group methods—J. W. Bridges and K. M. B. Bridges
6. The influence of puberty praecox upon mental growth—A. Gesell

VOLUME 2—1927

1 & 2. The mind of a gorilla—R. M. Yerkes
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4. Family similarities in mental-test abilities—R. R. Willoughby
5. Coordination in the locomotion of infants—L. H. Burnside
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VOLUME 3—January-June, 1928

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5. Objective differentiation between three groups in education (teachers, research workers, and administrators)—M. B. Jensen
6. The effect of segregation on the sex behavior of the white rat as measured by the obstruction method—M. Jenkins

VOLUME 4—July-December, 1928

1. Observation and training of fundamental habits in young children—E. A. Bott, W. E. Blatz, N. Chant, and H. Bott
2 & 3. Determination of a content of the course in literature of a suitable difficulty for junior and senior high school students—M. C. Burch
4 & 5. Methods for diagnosis and treatment of cases of reading disability—M. Monroe
6. The relative effectiveness of lecture and individual reading as methods of college teaching—E. B. Greene

VOLUME 5—January-June, 1929

1. The age factor in animal learning: I. Rats in the problem box and the maze—C. P. Stone
2. The effect of delayed incentive on the hunger drive in the white rat—E. L. Hamilton
3. Which hand is the eye of the blind?—J. M. Smith
4. The effect of attitude on free word association-time—A. G. Ekdahl
5. The localization of tactual space: A study of average and constant errors under different types of localization—L. E. Cole
6. The effects of gonadectomy, vasotomy, and injections of placental and orchic extracts on the sex behavior of the white rat—H. W. Nissen

VOLUME 6—July-December, 1929

1. Learning and growth in identical infant twins: An experimental study by the method of co-twin control—A. Gesell and H. Thompson
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3. The acquisition and interference of motor habits in young children—E. McGinnis
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VOLUME 7—January-June, 1930

1. Tensions and emotional factors in reaction—E. Duffy
2. Teacher influence on class achievement: A study of the relationship of estimated teaching ability to pupil achievement in reading and arithmetic—H. R. Taylor
3 & 4. A study of the effect of inverted retinal stimulation upon spatially coordinated behavior—P. H. Ewert
5. A study of the mental development of children with lesion in the central nervous system—E. E. Lord
6. An experimental study upon three hundred school children over a six-year period—N. D. M. Hirsch

VOLUME 8—July-December, 1930

1 The amount and nature of activities of newborn infants under constant external stimulating conditions during the first ten days of life—O. C. Irwin
2. Race and social differences in performance tests—S. D. Porteus, *et al.*
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4. Eye-movements and optic nystagmus in early infancy—J. M. McGinnis
5 & 6. Reactions of kindergarten, first-, and second-grade children to constructive play materials—L. Farwell

VOLUME 9—January-June, 1931

1 & 2. The status of the first-born with special reference to intelligence—H. H. Hsiao
3 & 4. An experimental study of bright, average, and dull children at the four-year mental level—H. P. Davidson
5. An historical, critical, and experimental study of the Seashore-Kwalwasser test battery—P. R. Farnsworth
6. A comparison of difficulty and improvement in the learning of bright and dull children in reproducing a descriptive selection—F. T. Wilson

VOLUME 10—July-December, 1931

1. A comparative study of a group of southern white and negro infants—M. B. McGraw
2 & 3. An experimental study of prehension in infants by means of systematic cinema records—H. M. Halverson
4. The limits of learning ability in kittens—A. M. Shuey
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VOLUME 11—January-June, 1932

1. General factors in transfer of training in the white rat—T. A. Jackson
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4. A critical study of two lists of best books for children—F. K. Shuttleworth
5 & 6. Measuring human energy cost in industry: A general guide to the literature—R. M. Page

VOLUME 12—July-December, 1932

1. Family resemblances in verbal and numerical abilities—H. D. Carter
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VOLUME 13—January-June, 1933

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2. A study of the nature, measurement, and determination of hand preference—H. L. Koch, *et al.*
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4. The relation between the complexity of the habit to be acquired and the form of the learning curve in young children—M. L. Mattson
5. Eating habits in relation to personality development of two- and three-year-old children: a study of sixty-nine

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4. Limits of learning ability in the white rat and the guinea pig—B. F. Riess

5 & 6. The limits of learning ability in rhesus monkeys—H. A. Fjeld

VOLUME 16—July-December, 1934

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VOLUME 17—January-December, 1935

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   Graphic representation of a man by four-year-old children in nine prescribed drawing situations—P. F. Gridley
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   A study of the vocational interest trends of secondary school and college women—A. M. Cawley

VOLUME 36—July-December, 1947

1. Maze test validation and psychosurgery—S. D. Porteus and H. N. Peters
2. The diagnostic implications of Rorschach's test in case studies of mental defectives—I. Jolles

VOLUME 37—January-June, 1948

1. The radio day time serial: A symbolic analysis—W. L. Warner and W. E. Henry
   The relation of personality characteristics and response to verbal approval in a learning task—G. L. Grace
2. The mechanism of vision: XVIII. Effects of destroying the visual "associative areas" of the monkey—K. S. Lashley
   A study of the relationship between handwriting and personality variables—P. Castelnuovo-Tedesco

VOLUME 38—July-December, 1948

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Genetic Psychology Monographs *(continued)*

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VOLUME 48—July-December, 1953

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Genetic Psychology Monographs *(continued)*

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(Manuscripts are printed in the order of final acceptance)

Dogmatism and divergent-convergent abilities 3
By Michael J. Uhes and James P. Shaver

Alienation: Another dimension of underachievement 13
By Martin M. Propper and Edward T. Clark

Behavioral reactions of Wistar rats to conditioned fear stimuli, novelty, and noxious stimulation 19
By Norman D. Henderson

Lysergic Acid Diethylamide (LSD 25): XXXIX. The effect of high temperatures on stability 35
By H. H. Gettner, A. Rolo, and H. A. Abramson

On the use of parametric statistical techniques to assess the on-off characteristics of speech 41
By Stephen Breskin and Joseph Jaffe

(OVER)

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Critical flicker frequency and integrative functions in Parkinsonism . . . 45
BY MANUEL RIKLAN, ERIC LEVITA, AND HENRY MISIAK

The effect of reversal of premises on children's deductive reasoning ability . 53
BY JAMES J. ROBERGE

E. G. Boring and the *Zeitgeist: Eruditione gesta beavit* 59
BY SAUL ROSENZWEIG

Effects of knowledge of results and method of payoff on keeping-track performance. 73
BY ROBERT KARSH, RICHARD A. MONTY, AND HARVEY A. TAUB

Alteration of mood via music: A study of the vectoring effect 81
BY LEO SHATIN

A method and model for automated assessment of human judgment . . . 87
BY ROBERT E. SHIPLEY, CARROLL E. POWELL, AND R. N. HARLEY

Dissonance *versus* contrast in an ego-involved situation with disconfirmed expectancies 107
BY KENNETH C. MACE AND RUSSELL F. ENZIE

The relationship of figural after-effects and geometrical illusions to successive and simultaneous contrasts 123
BY ROY DREISTADT

Published as a separate and in *The Journal of Psychology,* 1970, **75,** 3-11.

DOGMATISM AND DIVERGENT-CONVERGENT ABILITIES*[1]

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A. INTRODUCTION

Research findings on the relationship between level of dogmatism, as measured by Rokeach's scale (21), and intellectual ability show considerable inconsistency (28). The variability in research findings seems to be a product of how various researchers have operationally defined cognitive ability. That is to say, psychologists do not agree on how to best estimate cognitive ability (13, 26). Some researchers assume that cognitive ability is best reflected by the ability to learn. With the use of this definition as a basis for measurement, consistently negative relationships are found between dogmatism and cognitive ability (1, 4, 7, 9, 20). When scores on group administered intelligence tests are used as the index of cognitive ability, no consistent relationship appears (2, 6, 21, 28).

To the extent that the confusion in research results is due to differing descriptions and measurements of cognitive abilities, use of a model of structure of intellect such as Guilford's (11) seemed to provide the most promising basis for experimentally testing differences in cognitive ability between high and low scorers on Rokeach's Dogmatism Scale (21). According to Guilford (13), each of the primary factors in cognitive functioning can be thought of as possessing a combination of three dimensions: one referring to the content of the material dealt with, a second to the operations performed on the material, and a third to the products achieved by the operations. The second of these dimensions, cognitive operations (divergent and convergent), seemed particularly likely to be related to differences in level of dogmatism (1, 4, 18).

Researchers dealing with divergent operations have usually considered them to involve creative production (12), while convergent operations have been emphasized as involving the production of conventionally accepted responses. Wrenn (27) and Terhune (25) found that highly dogmatic individuals

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tended to accept group conformity and to value reinforcement by group thinking. This embracing of prescribed views appears dissonant with research findings on the necessary conditions for creative production (10, 24). In a speculative vein, Rokeach (22) suggested that open-mindedness might be a necessary, yet insufficient, condition for creative production. In testing this relationship, Jacoby (14) did not find a significant relationship between open-mindedness and creativity as defined by Mednick (17). However, taking note of his rather small sample *N*, he noted (17, p. 822) that "the results are suggestive and it appears that further research into the relationship between dogmatism and creativity is warranted."

The objectives of the present study were to examine the relationship between dogmatism and ability to perform convergent and divergent operations. The two tests selected to measure divergent abilities yielded scores for the three factors which are considered crucial for creative production (12). They are spontaneous flexibility, ideational fluency, and originality. Counterpart convergent ability tests were administered to provide measures of a contrasting type of cognitive operation. Accordingly, the following hypotheses were tested:

Hypothesis I. Groups of high and low dogmatic *S*s will have significantly different flexibility, fluency, originality, and composite divergent ability scores.

Hypothesis II. High dogmatic *S*s will have a higher mean standard composite score on tests of convergent abilities than on tests of divergent abilities.

Hypothesis III. Low dogmatic *S*s will not have a higher mean standard composite score on tests of convergent ability than on tests of divergent ability.

B. METHOD

1. *Subjects*

Three-hundred and sixteen high school students (165 males, 151 females) in a mixed urban-rural high school in Utah participated in the initial phase of the experiment. The total population was administered Rokeach's Dogmatism Scale, Form E, and *S*s' scores were used as a screening device to identify the experimental groups. *S*s were placed in the high dogmatic group if their scores fell in the top 10 percent of the sample population, and in the low dogmatic group if they fell in the bottom 10 percent of the distribution. Another group of those *S*s in the middle 10 percent of the dogmatism distribution was comprised as previous research has focused only on high and low dogmatic *S*s. An estimate of intelligence, the G factor from the General Aptitude Test Battery, was available on all *S*s. An analysis of variance showed the experimental groups to be homogeneous with regard to intelligence as measured by the G.A.T.B. (see Table 1). For the population, the correlation between Dogmatism and G Factor scores was a nonsignificant —.13.

2. *Measures*

Having defined the experimental groups on the basis of dogmatism scores, two measures of divergent and two measures of convergent ability were administered. Guilford (13) pointed out that the best method of estimating divergent-convergent production ability is to administer tests which are heavily loaded on these factors, but which keep the products and contents of the productions constant. With this rationale in mind, the Alternate Uses and Consequences Test (divergent operations) and the Gestalt Transformations and Word-Group Naming Tests (convergent operations) were administered. The tests of divergent operations were chosen because of the availability of validity estimates (3, 16); the tests of convergent operations were then fixed by the need to keep the products and contents constant.

The Dogmatism Scale, Gestalt Transformations, and Word-Group Naming Tests are objectively scored with no interpretation called for. On the other hand, the Alternate Uses Test and the Consequences Test (which yields two scores), necessitate scorer judgments. In order to establish interscorer reliability, two judges scored the tests for a sample of 25 *S*s. The Pearson product-moment correlation coefficient to estimate interscorer reliability on the Alternate Uses Test was .98. For the originality score on the Consequences Test, the interscorer reliability coefficient was .79, while for the fluency score on the Consequences Test, it was .95. A composite divergent ability score was obtained using weightings suggested by Deak (5). A total score for convergent production ability was obtained by summing the totals on both the Word-Group Naming and Gestalt Transformation Tests.

C. RESULTS

The mean fluency, flexibility, originality, composite divergent, and composite convergent ability scores for the experimental groups are presented in Table 1. As can be seen, the experimental groups did not differ in ideational fluency. However, significant differences were obtained on flexibility, originality, composite divergent, and composite convergent ability scores.

A comparison of group means, two at a time, was carried out for each significant *F*-ratio with the use of Scheffe's (23) method. The results are presented in Table 2. In each instance, the low dogmatic *S*s' mean was higher than that of the high dogmatic *S*s; the low dogmatic *S*s' mean was also higher

TABLE 1

COMPARISON OF EXPERIMENTAL GROUPS ON INTELLIGENCE, FLUENCY, FLEXIBILITY, ORIGINALITY, COMPOSITE DIVERGENT, AND COMPOSITE CONVERGENT ABILITY SCORES

	Experimental groups						
	High dogmatic		Medium dogmatic		Low dogmatic		
	$\overline{X} = 211.06$	$SD = 5.12$	$\overline{X} = 171.80$	$SD = 2.52$	$\overline{X} = 126.80$	$SD = 9.59$	
Measures	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Intelligence (G Factor)	103.12	12.96	107.88	12.16	111.80	16.98	2.34
Fluency	23.80	10.69	28.73	10.78	29.35	11.51	2.37
Flexibility	12.60	5.52	14.36	4.70	16.56	7.32	3.18*
Originality	3.73	2.83	5.40	3.46	9.27	5.86	13.55**
Comp. div.	58.73	20.50	68.60	20.20	74.66	30.49	6.58**
Comp. con.	14.86	5.08	15.56	4.19	18.60	4.20	5.82**

* $p < .05$.
** $p < .01$.

than that of the medium dogmatic group on the originality and composite convergent ability scores. In no instance was the medium dogmatic *S*s' performance significantly different from the high dogmatic *S*s' performance. Thus, with the exception of the flexibility measure, Hypothesis I was retained.

TABLE 2
MEAN DIFFERENCES BETWEEN EXPERIMENTAL GROUPS ON FLEXIBILITY, ORIGINALITY, COMPOSITE DIVERGENT, AND COMPOSITE CONVERGENT ABILITY SCORES

Measure	Group comparisons		
	High *vs.* Low	High *vs.* Medium	Low *vs.* Medium
Flexibility	3.74*	1.76	2.20
Originality	5.54**	1.67	3.87*
Com. div.	15.93**	9.87	6.06
Com. con.	3.74**	.70	3.04*

* $p < .05$.
** $p < .01$.

Hypothesis II stated that high dogmatic *S*s would perform convergent operations better than divergent operations. In order to test this hypothesis, the raw composite convergent and divergent ability scores for each individual in the high dogmatic group were converted to standard scores. A *t*-test of the differences between two means for correlated samples was computed (8).

The results are presented in Table 3. The high dogmatic *S*s did perform convergent operations better than they performed divergent operations. Therefore, Hypothesis II was retained.

TABLE 3
T-TESTS FOR THE DIFFERENCES BETWEEN DIVERGENT AND CONVERGENT SCORES OF HIGH AND LOW DOGMATIC SUBJECTS

Subjects	Mean Composite divergent	Mean Composite convergent	*T*-ratio
High dogmatic	—.315	—.029	2.193*
Low dogmatic	.612	.594	.021

* $p < .05$.

Hypothesis III stated that groups of low dogmatic *S*s would perform divergent and convergent operations equally well. Again, the *S*s' raw scores were converted to standard scores and the appropriate *t*-test computed. As can be seen in Table 3, low dogmatic *S*s performed divergent and convergent operations equally well. Hypothesis III was retained.

In order to assess the magnitude of the relationship between dogmatism and divergent-convergent abilities, Pearson product-moment correlation coefficients were computed between level of dogmatism and each of the ability measures for a sample of 184 *S*s. The results are presented in Table 4. Level of dogmatism is negatively correlated with flexibility, originality, composite divergent, and composite convergent ability scores.

TABLE 4

CORRELATIONS BETWEEN LEVEL OF DOGMATISM AND FLUENCY, FLEXIBILITY, ORIGINALITY, COMPOSITE DIVERGENCE, AND COMPOSITE CONVERGENT ABILITY SCORES

	Fluency	Flexibility	Originality	Com. div.	Com. con.
Dogmatism	—.145	—.20**	—.29**	—.26**	—.18*

* $p < .05$.
** $p < .01$.

D. DISCUSSION

The data are quite clear with regard to the relationship between level of dogmatism and divergent ability. In every instance, save one, the two dimensions were negatively correlated. The only divergent dimension not related to level of dogmatism was ideational fluency. That is to say, level of dogmatism is not correlated with the number of responses individuals make in a problem-solving situation; however, when responses are evaluated either for originality or flexibility, differences appear.

Inspection of the mean divergent ability scores for the different levels of dogmatism was helpful in interpreting the relatively low magnitude of the correlation coefficients reported in Table 4. As can be seen in Table 2, most of the between group variance was accounted for by the magnitude of the differences between the low dogmatic group and the other two groups. That is, the relationship between level of dogmatism and divergent ability measures used in this study was not linear. Further research on a broader population is needed to determine if the curvilinear relationship between level of dogmatism and divergent ability is a general pattern.

The use of the composite divergent ability score was helpful in highlighting the trends present in the *S*s' performance on the measure's component parts. The composite divergent ability score was negatively correlated with level of dogmatism, and in the experimental groups, high and low dogmatic *S*s had significantly different mean divergent ability scores, although the medium group did not differ significantly from the high group. Thus, if one were to speak of "divergent" ability rather than the component parts, he would be justified in concluding that, in this sample, the more dogmatic the individual, the less likely it was that he would be able to generate information when the emphasis was upon variety and quantity of output from the same source. This operation appears to be the one most clearly involved in measuring aptitude for creative potential (12).

Convergent production has been spoken of as production by compelling inference (13); that is, production where the input of information is sufficient to determine an answer and where the focus is upon the attainment of conventionally accepted outcomes. Given this definition, there was no reason to suspect that such production would be related to level of dogmatism. This, however, was not the case. Level of dogmatism was negatively correlated with convergent production in our total population ($r = -.18$, $p < .05$). In the analysis of the experimental groups' performances, it was found that low dogmatic *S*s had higher mean scores than either medium or high dogmatic *S*s on convergent production tests. This finding is consistent with Moore's (18) finding that the high dogmatic *S* does not respond to verbal conditioning as readily as the low dogmatic *S*. Assuming that verbal praise was reinforcing, Moore concluded that the high dogmatic *S* had difficulty discriminating among the more obvious stimuli he received from his environment. Similarly, inadequate discrimination ability may be a factor in the relatively poorer performance of the high dogmatic *S*s on tests of convergent operations. They may not be capable of making profitable discriminations even when the focus is upon the logical and the conventional.

The difference between the high dogmatic *S*s' ability to produce divergently and convergently seemed central to a thorough description of our experimental groups (see Table 3). It was found that high dogmatic *S*s did perform convergent operations better than they performed divergent operations. Conversely, it was found that low dogmatic *S*s performed convergent and divergent operations equally well. This finding seems to have particular relevance for those concerned with the interaction between student personality and teaching style (15) and for those concerned with building curricula most effective for differing cognitive styles (19).

Attempts to relate dogmatism to cognitive abilities measured in terms of tests of general intelligence and/or ability to learn have left much to be desired. On the basis of the present study, it appears that the use of tests which have evolved from Guilford's model of the structure of intellect may provide researchers with more effective means of untangling the Gordian knot we presently call cognitive ability.

E. SUMMARY

On the basis of previous research in dogmatism and intellective ability, it was predicted that low dogmatic high school *S*s would have superior fluency, flexibility, originality, and composite divergent ability scores as compared to

high dogmatic *S*s. Mean scores on flexibility, originality, composite divergent, and composite convergent abilities tests were higher for low dogmatic *S*s in a population homogeneous in terms of general intelligence. High dogmatic *S*s performed convergent operations better than they performed divergent operations, while low dogmatic subjects performed both operations equally well.

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ALIENATION: ANOTHER DIMENSION OF UNDERACHIEVEMENT*

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A. INTRODUCTION

A considerable literature exists on underachievement and its relationship to certain personality factors. In reviewing this literature, Shaw (15) suggested a rethinking of the meaning of academic underachievement.

This study related varying levels of academic achievement to Davids' conceptualization of alienation. Five personality traits of pessimism, distrust, anxiety, egocentricity, and resentment have been defined by Davids (4) as components of the alienation syndrome. Thus, in contrast to traditional sociological descriptions of alienation as powerlessness, normlessness, meaninglessness, and self-estrangement (9), this research provided an empirical evaluation of alienation as a psychological construct among adolescent males. It should also be noted that Davids' alienation variables, despite considerable similarities to psychodynamic factors in personality, are perceived primarily as overt behavior traits, revealed on a conscious level by the individual, and completely within one's introspective and self-evaluative capacities (7).

Among bright affluent adolescents it is reasonable to expect the majority to attain high levels of scholastic achievement. Nevertheless, it has become increasingly apparent that there are many whose academic performance is markedly discrepant in terms of the normative demands placed upon them. This study sought to ascertain whether the adolescent who rejects such normative demands for academic achievement in a bright upper middle class setting is also the individual who meets Davids' criteria of the "alienated man."

In an intensive study of intellectually capable underachievers Lichter, Rapien, Seibert, and Sklansky (11, p. 245) concluded that these students were "wasting their mental capacities, dissipating their opportunities, and circumscribing their chances for a better life." Recent efforts to characterize the underachiever highlight the following: individual associalization (12), a minimal concern for the opinion of others and an externalization of responsibility

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and conflicts (13), and a significantly different level of emotional maturity, self-assurance, and intellectual efficiency from that of the high academic achiever (6). Each of these characteristics parallels the component traits of Davids' alienation syndrome.

With the spread of "a new tide of alienation . . . (involving) a sense of disillusionment with traditional politics, dislike of University Hall, opposition to the war in Vietnam, impatience of the slowness of emancipation of Negro Americans" (8, p. 326), from university to high school students, campus ferment, whether in the form of the violent confrontations or the passive "dropping out," are both indicative of an overt rejection of dominant values, roles, and institutions of society by a privileged sector of American youth. Keniston (8) sees alienation as an almost inevitable consequence of our modern society which will afflict significant members of our most talented youth. Thus, in studying this affluent subculture, as contrasted to the disadvantaged and seriously disturbed among whom alienation is deeply rooted, a keener awareness of the phenomenon of alienation may be found among adolescents who have been provided all the possible advantages available in contemporary American society. In accord with this need, this investigation has sought to identify a profile of psychologically defined alienation traits related to underachieving bright adolescents who are potential sources of serious human and social waste.

The study tested the hypothesis that in both Bright and Superior Mental Ability groups Low Academic Achievers will reveal significantly more of the alienation syndrome than High Academic Achievers.

B. METHOD

1. *Subjects*

The subjects were 80 male seniors in a suburban public high school in the vicinity of New York City. This school serves a community in which the residents are predominantly Jewish (83 percent) and with a family mean income of $25,000. More than 90 percent of the high school's graduating class enters college. The subjects were divided into two groups: Bright (BMA, *IQ* 110-125) and Superior (SMA, *IQ* 126-140) Mental Ability groups on the basis of *IQ* scores. Then, employing regression equations, High (HAA) and Low (LAA) Academic Achievers were identified within each of these *IQ* groups. LAA is used synonomously with an underachiever of high mental ability and low academic performance in terms of grades.

2. *Procedure*

In group testing sessions two objective measures—Affect Questionnaire (AQ), Self-Rating Scale (SR)—and three projective measures—Sentence Completion Test (SCT), Word Association Test (WAT), Thematic Apperception Test (TAT)—were administered in the sequence WAT, SCT, TAT, AQ, and SR. Each test independently assessed the five component traits of the alienation syndrome (4).

C. RESULTS

The results of the interscorer reliability checks on the three projective measures compare quite favorably with previous reliability investigations (2, 5, 7, 16). All correlations between *IQ* and the five tests were not significant, and therefore, eliminated intelligence as a significant factor in the results of this study.

Table 1 reveals that in both BMA and SMA groups LAA showed signif-

TABLE 1
RESULTS OF ANALYSIS OF VARIANCE AND PLANNED COMPARISONS ON THE ALIENATION MEASURES

Test	Source	*df*	*SS*	*MS*	*F*
AQ	Groups	3	13206.55	4402.18	9.06**
	BL *vs.* BH	1	5712.20	5712.20	11.76**
	SL *vs.* SH	1	20480.00	20480.00	42.16**
	Error	76	36919.00	485.77	
SR	Groups	3	3748.24	1249.41	8.41**
	BL *vs.* BH	1	3645.00	3645.00	24.56**
	SL *vs.* SH	1	4004.45	4004.45	26.99**
	Error	76	11277.75	148.39	
SCT	Groups	3	427.05	142.35	4.22**
	BL *vs.* BH	1	192.20	192.20	5.70*
	SL *vs.* SH	1	649.80	649.80	19.28**
	Error	76	2562.50	33.71	
WAT	Groups	3	691.04	320.34	8.16**
	BL *vs.* BH	1	966.05	966.05	34.25**
	SL *vs.* SH	1	405.00	405.00	14.36**
	Error	76	2143.95	28.20	
TAT	Groups	3	1504.24	501.41	6.40**
	BL *vs.* BH	1	819.20	819.20	10.46**
	SL *vs.* SH	1	1786.05	1786.05	22.81**
	Error	76	5950.45	78.29	

* $p < .05$.
** $p < .01$.
Note: BL = LAA in BMA; BH = HAA in BMA; SL = LAA in SMA; SH = HAA in SMA. AQ = Affect Questionnaire; SR = Self-rating Scale; SCT = Sentence Completion Test; WAT = Word Association Test; TAT = Thematic Apperception Test.

icantly more of the alienation syndrome than corresponding HAA on all five measures. Nine of the ten planned comparisons were significant at the .01 level. It can, therefore, be concluded that the different levels of academic achievement, irrespective of level of mental ability, reveal differential amounts of the alienation syndrome.

Intercorrelations among the five measures were all significant ($p < .01$), which compare favorably to Clark and Propper's (3), and Davids and Pildner's (7) findings. These results present strong evidence that the projective tests measure the same personality traits revealed by the direct techniques.

D. Discussion

This study strongly suggests that nonachievement is related to a new psychological dimension among young men for whom so much is given, and who have responded to subcultural pressures for conformity with a rejection of these demands. More specifically, the low academic achiever (LAA) identified in this study can be characterized by Davids' (4) profile of the "alienated man."

This association between the alienation syndrome and underachievement has several theoretical, as well as practical, implications that deserve careful scrutiny. It may represent a new trend among bright students whose performance is quite unimpressive. The results seen in accord with Kowitz's (10, p. 473) description of the underachiever as a "rebel against the educational regime . . . (who) has chosen a path of passive nonresistance to instruction rather than one of active aggression against it," and Gough's (14) concept of underachievement as similar to that of juvenile delinquency. It would also appear that mediocre students in this population may be achieving academic credentials which will gain them admission to first rate institutions, whereas bright alienated students may have foreclosed many opportunities.

If these personality and motivational characteristics, as represented in the alienation syndrome, are significantly related to academic achievement, one may infer that these traits preclude the effective societal utilization of the LAA's intellectual resources in an academic setting. This relationship also suggests that underachievement may itself represent a self-defeating form of adolescent rebellion. The question of whether, at any level of education, there is a rationale for an integration of psychological and educational needs, seems to arise from this established association. This study may have explored psychological as well as educational underachievement, and future efforts should determine whether the association represents maladjustment due to this lack of integration.

It is also unclear whether this association suggests a new mode of adjustment among this subsample, from whom so much is expected and to whom so much is given, or something that has always existed among previous generations of adolescents. However, the rise in drug users, hippie communities, malcontents, and student revolts present strong evidence that alienation is manifesting itself among modern youth in a very different, if not unique, manner than among previous generations. It should be noted that the evolution of such groups does not imply that all those affiliated are "bad," and that LAA identified by this study are "undesirables." Future efforts might explore whether this psychological construct of alienation implies a moral judgment on anyone who opposes the establishment or does not fit into society, and to what degree are the component traits of the alienation syndrome desirable in our youth as representative of aware, active participants in a free society. Bloy's (1, p. 493) view of the "process of alienation as a possible force for creative change and not just as an illness to be healed," may be confirmed in future investigations and empirical observations. Potential differences in the expression of these dimensions of alienation might be explored among the various existing youth groups to confirm or deny these speculations about the predictive validity, as well as the practical implications, of this alienation syndrome.

In accord with these speculations it remains to be seen whether this alienation is (*a*) a normative trend, (*b*) a transitory phenomena, or (*c*) a deviant aspect of psychological development. Despite the dichotomy of HAA and LAA in terms of the alienation syndrome, alienation may also be conceived of as a more normative predisposition in modern adolescents. Keniston (8, p. 342) makes the most emphatic implication of a normative alienation trend in his contention that "a continuing group of the most talented, sensitive, and suitably predisposed of our youth will be repelled by our society, and will experience a transient and, in many cases, an enduring phase of alienation."

E. SUMMARY

The dimensions of Davids' alienation syndrome—pessimism, distrust, anxiety, egocentricity, and resentment—significantly dichotomized High and Low Academic Achievers between both Bright and Superior Mental Ability groups of upper middle class male adolescents. Five independent projective and objective measures of the alienation syndrome were employed, and all intercorrelations among the tests were significant ($p < .01$). It appears that these alienation traits are seriously interfering with the effective societal use of the LAA's intellectual resources. The need for a keener awareness of this psychological

construct of alienation is strongly indicated by the spread of university upheavals and unrest to high school populations.

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BEHAVIORAL REACTIONS OF WISTAR RATS TO CONDITIONED FEAR STIMULI, NOVELTY, AND NOXIOUS STIMULATION* [1]

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A. INTRODUCTION

Investigators studying the behavior of mice and rats have frequently used measures of ambulatory activity, defecation, latency to react to a stimulus, and grooming as indices of "emotionality" in their *S*s. The use of these measures stems partly from the original work of Hall (7, 8) who defined emotionality as "a general upset or excited condition of the animal" (7, p. 385), and from several other investigators whose work is summarized in Hall's review of studies of temperament (9).[2] Most of this early research and more recent studies (e.g., 13, 14), using intersubject correlational techniques indicated that when strain and sex differences are partialed out, correlations between all but contingent measures are usually low, suggesting that "emotionality" is not a unitary factor whose magnitude can be estimated by one or two behavioral scores.

It has been frequently noted, however (e.g., 11, 12, 15), that interindividual correlations may be inadequate for validating certain types of constructs, including those related to indices of arousal, thus low intersubject correlations between various behaviors are not necessarily conclusive evidence that these behaviors do not reflect in part some common element. In an attempt to circumvent problems created by analysis of between-*S* covariation, a series of experiments were carried out to examine the within-*S* changes that occur in certain behaviors when *S*s are confronted with a variety of types of fearful stimuli. It is reasonable to expect that the variety of behaviors loosely defined as indices of emotion or fear by various investigators should show some within-*S*

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[2] Although Hall originally used the term "emotionality" to describe the general upset or excited condition of the animal (7), he later (9) equated terms such as fearfulness, timidity, nervousness, and excitability with emotionality, since little operational differentiation existed between these constructs in animal research.

consistencies when *S*s are confronted with situations which are generally concurred to be fear eliciting by investigators of animal behavior. Furthermore, to be a generally useful index of emotionality the change in a given behavior in the presence of fearful stimuli should be consistent from subject to subject and be more or less independent of the specific test situation in which it is observed. In the present series of experiments several behaviors are observed in a variety of test situations, where *S*s are exposed to either classical fear conditioning, novelty, or noxious stimulation.

B. Experiment 1: Conditioned Fear Reactions

1. *Method*

a. Subjects. *S*s were 10 male and 10 female Wistar rats ranging in age when conditioning began from five to 20 weeks. A wide range of ages was purposely chosen to ensure that any positive results were not age specific. All *S*s in this and succeeding experiments were born in the laboratory in Keystone #108 plastic cages, where they remained undisturbed until weaning at 23 days of age. In order to randomly sample a variety of laboratory rearing conditions prior to testing, two males and two females were each raised in one of the following conditions: individually caged in colony room, with same sexed *S* in colony room, individually caged in testing room, with same sexed *S* in testing room, or with same sexed *S* in 9 ft. × 9 ft. open area. The colony room was on a 13-hr.-light/11-hr.-dark cycle, was maintained at a constant 76°-79° F temperature, and had little human traffic. The testing room, on the other hand, was frequently occupied by experimenters, had no light cycle control, and contained all the behavioral testing apparatus used in the experiment. *S*s caged in this room were removed during testing periods for other *S*s.

b. Apparatus. The CS used in conditioning was a 1000cps tone generated by a Hewlett Packard 200 ABR tone generator. The shock apparatus used to provide the US for initial conditioning was an enclosed 10-in. × 6-in. × 7-in. box with clear plastic front and top and stainless steel grid floor. The grid was connected to a 1150Vac constant current shock source which provided a shock of 1.0±.06 ma. to all *S*s. An additional 115Vac .8±.2 ma. shock source was used to deliver the US through electrodes implanted in *S*. The behavioral test apparatus described below was used in both experiments 1 and 2.

The open field was 36 in. square with 24-in. walls painted flat black and a floor covered with white plastic. In the center of the field 18 in. above the floor a 150w floodlamp provided illumination of 800 foot candles on the floor directly beneath. Photoelectric beams bisected each side of the field, dividing the floor into four equal 18-in. quadrants. When S crossed either beam a count was registered, the total counts serving as an estimate of S's ambulatory activity.

The Dashiell-type maze was 40 in. × 5 in. high, with 4-in. wide runways formed around nine 8-in. × 8-in. closed inner squares. The maze was made of plywood except for the top which was covered with hardware cloth. A 150w floodlamp 24 in. above the center illuminated the maze. For purposes of scoring, the alleys of the maze were marked off in 4-in. × 8-in. and 4-in. × 4-in. rectangles.

The elevated runway consisted of a 4-in. wide board 84 in. long suspended between two 16-in. × 16-in. platforms 18 in. above the floor. The runway was marked off from the center into 14 6-in. lengths for scoring activity. The closed runway, also 84 in. long and 4 in. wide, had 6-in. high walls and 12-in. × 12-in. goal boxes. The top was covered with hardware cloth, the walls and floor painted flat black, and the latter marked off from the center in 6-in. lengths.

The water tank consisted of a 12-in. high, 24 in. in diameter tub, filled with 7 in. of water, 76°F. Suspended in the center of the tub was a 7-in. high cylinder 5 in. in diameter with its bottom edge 1 in. below the water level. The cylinder was held in place by two wires stretched between the upper rims of the cylinder and the tub. A 5-in. × 10-in. hardware cloth ladder extended from the water to a 10-in. × 16-in. platform next to the upper rim of one side of the tub.

c. Procedure. Fear conditioning. Two days prior to beginning conditioning Ss were placed under light ether anesthesia and stainless steel wire electrodes were implanted subcutaneously in both lateral mid-thoracic regions and in the dorsal lumbar region. Initial conditioning consisted of placing S in the shock box and presenting a two-minute 1000cps tone, followed by a two-second, 1 ma. unavoidable shock, .7 second after CS termination. Ten trials of this type were carried out on each of two days. Intertrial intervals were five minutes. Following the 20 shock box trials, conditioning was continued in a variety of environmental situations (home cages, table tops, solid wall boxes) administering the US either through the two lateral electrodes or through the dorsal electrode and a metal surface S was standing on. The purpose of this procedure was to produce a conditioned fear which was associated only with the tone and not with specific surroundings, floors, or electrode connections. The length of the CS during this second phase of conditioning was randomly varied from 30 to 120 seconds. Daily blocks of 10 trials were run using these procedures for seven days. On each consecutive day the number of CS presentations followed by shock was decreased by one, thus at the end of the training session *S*s were receiving shock after only 40 percent of the CS presentations.

d. Design for behavioral testing. *S*s were given seven behavioral tests, five in the apparatus described and two in their home cages. One test was run on each day and the order of the test situations was randomly determined for each *S*. After behavioral testing was completed on test days 3 and 6, *S* was given two paired CS-US trials to maintain a high level CR to the tone. Each behavioral test involved two, two-minute trials in the apparatus, spaced 15 minutes apart. One trial was carried out with the CS on, the other without CS. In each situation half of the male and female *S*s were randomly chosen to receive the CS presentation on the first trial, while the remainder received CS on trial 2.

e. Scoring procedures for each test.

(1). *Open field.* *S* was placed in one corner of the open field and the timers, overhead light, and photocell counters were activated. The latency to cross the first photocell beam and the total number of crossings was recorded, as well as the number of fecal boluses and grooms which occurred during the two-minute test trial. As groom was defined as any period in which *S* ceased ambulation and used both forepaws to stroke around the face and head. These periods usually lasted from two to 10 seconds. In this test and other tests *S* was returned to its home cage at the end of the trial for 15 minutes, after which time the above procedure was repeated. One of the two trials was conducted in silence, the other with the CS. In this and subsequent tests *E* always remained at least 5 ft. from *S* during observation.

(2). *Dashiell maze.* *S* was placed in one corner of the maze and allowed to explore freely. *E* traced the path of *S* on a prepared diagram and recorded the number of grooms and fecal boluses, and the total number of times *S* crossed into another square was used as the ambulation measure. Nearly all *S*s crossed one or more of the lines immediately upon being placed in the maze, making latency to move measure useless in this test. Trial 2 was carried out after 15 minutes as above.

(3). *Closed and open elevated runways.* *S* was placed across the middle of the runway and latency to reach either goal box was recorded along with the total number of lines crossed during the test period, the latter again being used as an index of general ambulatory activity.

(4). *Latency to drink.* *S* was water deprived for 23 hours prior to testing. The home cage was placed in the experimental room and a standard water bottle was hung on the home cage door. The latency to first begin drinking was then recorded with a maximum latency of two minutes allowed.

(5). *Cage emergence.* *S*'s home cage was placed on a rotating platform (30rpm) for one minute. The cage was then placed on a flat surface and the door opened. The time to emerge with two front paws was recorded, with a maximum of two minutes allowed.

(6). *Water tank.* *S* was dropped into the small cylinder in the center of the tank. *S* could then escape by either swimming under the cylinder and toward the platform at the rim of the tank, or climbing along the wire suspending the center cylinder. This procedure was repeated twice during each trial and *S* remained either in the tank or on the platform for a total of two minutes. The total number of fecal boluses produced during the trial was recorded.

2. *Results*

Each test situation provided data which could be analyzed by a 2 × 2 × 2 repeated measures analysis of variance with sex, order of tone presentation, and presence or absence of CS as the main factors. Of prime interest was the last factor which indicated the change of behavior which occurred during CS presentation. In order to approximate more closely the assumptions underlying the analysis of variance procedure, defecation, and grooming scores, which roughly followed poisson distributions, were transformed to the form $\sqrt{X}$ $+ \sqrt{X+1}$; ambulation scores were transformed to the form $\sqrt{X}$; and latency measures were recorded in log seconds.

Table 1 summarizes the mean transformed scores for *S*s in each of the test situations, with and without the CS. It can be seen that consistent behavior patterns do emerge in all of the test situations. The CS increases defecation and latency scores and decreases ambulation and grooming. In terms of statistically significant changes, however, only the defecation measure produced significant changes in the majority of the tests. The high defecation score dur-

TABLE 1
MEAN TRANSFORMED SCORES FOR SUBJECTS DURING SILENT AND CS PRESENTATION PERIODS

Test	Defecation		Ambulation		Latency to act		Grooming	
	Silent	Tone	Silent	Tone	Silent	Tone	Silent	Tone
Open field	2.25	3.64*	2.28	1.37	1.24	1.30	2.08	1.75
Closed runway	1.65	3.05**	4.03	3.49	1.21	1.41	1.77	1.45
Open runway	2.26	2.31	5.19	4.93	1.39	1.69**	1.74	1.28**
Dashiell maze	1.65	4.14**	6.56	4.41**	.60	.60	1.65	1.20
Water tank	3.20	3.54						
Drinking cage					1.58	1.69	1.56	1.49
Home cage emergence					1.47	1.81*		

* $p < .05$.
** $p < .01$.

ing the silent period in the water tank may have been partially responsible for the failure to show a significant increase on this test during CS. A significant Order × CS interaction ($F = 9.7$, $df = 1/16$, $p < .01$) was due to higher defecation rates on first exposure to the tank whether CS was present or not. Sex differences occurred on two measures—females were more active in the open runway ($F = 6.6$, $df = 1.16$, $p < .02$) and took longer to begin drinking in the water deprivation test ($F = 10.2$, $df = 1/16$, $p < .01$). Three measures suggested that males were more reactive to the CS than females. During the CS males showed a significant decrease in grooming in the closed runway ($F = 6.3$, $df = 1/16$, $p < .02$) and a significant increase in latency to emerge from home cages ($F = 11.7$, $df = 1/16$, $p < .01$), while females exhibited no significant changes. Finally, although both sexes showed a decrease in activity during the CS in the Dashiell maze, males showed a greater decrease than females ($F = 4.5$, $df = 1/16$, $p < .05$).

C. Experiment 2: Repeated Exposures to the Testing Situations

1. *Method*

a. Subjects and apparatus. *S*s were 112 Wistar rats, 28 males and 28 females 4-6 weeks of age and 28 males and 28 females 9-11 weeks of age at the beginning of testing. All *S*s were born on shavings in Keystone #108 cages and were weaned at 21 days. After weaning *S*s lived with same sexed littermates in the colony room.

The testing apparatus was the same as that described in Experiment 1.

b. Procedure. The experiment was carried out in two replications one month apart. In each replication two males and two females from each of the two age levels were assigned to one of the seven test situations described in Experiment 1. For 10 consecutive days each *S* was given a two-minute test in the prescribed apparatus using the scoring procedures described in Experiment 1.

2. *Results*

Each test situation provided data which could be analyzed by a 2 × 2 × 2 × 10 repeated measures analysis of variance design, with age, sex, replication, and daily trend being the main factors. The data transformations used in Experiment 1 were also used to analyze these data. Of major interest is the change occurring over successive days. To assure that significant trend effects were due to consistent trends rather than to unusual daily fluctuations in the test conditions, the replications factor was considered a random variable. As recommended (20), Replications × Trend interactions were used to test trend effects, unless the interaction effect was not significant at the $p < .20$ level.

Significant trend effects were found in the defecation measures taken in the closed runway ($F = 3.2$, $df = 9/72$, $p < .01$), elevated runway ($F = 5.9$, $df = 9/72$, $p < .01$), and Dashiell maze ($F = 2.9$, $df = 9/72$, $p < .01$) and approached significance in the open field ($F = 1.9$, $df = 9/72$, $p < .08$) and water escape test ($F = 1.7$, $df = 9/72$, $p < .10$). The only significant trend effect found on the ambulation measure occurred in the Dashiell maze ($F = 4.3$, $df = 9/72$, $p < .01$). Latency to drink after deprivation showed a significant decrease on repeated testing ($F = 6.9$, $df = 1/72$, $p < .01$) and a significant trend effect was found on the latency to reach an end of the open runway ($F = 2.5$, $df = 9/72$, $p < .05$). Most *S*s frequently failed to emerge from the home cages within the two-minute limit on the cage emergence test, making latencies to emerge an inappropriate measure for analysis. An analysis of variance was therefore carried out on the number of days each *S* emerged from its home cage during the first five *vs.* the last five sessions. *S*s emerged significantly more times during the second block of five sessions than on the first block ($F = 11.7$, $df = 1/8$, $p < .01$). *S*s showed a significant increase in grooming on later trials in the open field ($F = 2.2$, $df = 9/72$, $p < .05$) and significantly less grooming on later trials in the Dashiell maze ($F = 2.4$, $df = 9/72$, $p < .05$). The frequency of grooming was too low for meaningful analysis of daily scores in the open runway and the drinking cage. Therefore analyses similar to that carried out on cage emergence (number of days grooming occurred on test sessions 1-5 *vs.* 6-10) were carried out on these measures. No significant differences were found on either test.

In addition to the general analysis of variance, trend analyses were carried out on all measures with significant trend effects. The linear component was significant in all of the measures, and the quadratic and cubic components were found significant on the defecation measure in the closed runway—these latter two components reflecting the irregular but gradual decrease in defecation on repeated trials on this test. The quadratic component was also significant on the Dashiell maze activity measure which reflected a gradually accelerating increase in activity on succeeding days. In no measure was there any significant evidence of a nonmonotonic trend in the data, nor were there any unusual changes from the first to the second day of testing which differed significantly from that predicted from the general trend over 10 days. Because of the essentially linear effects found, planned comparisons were carried out between the average scores on trials 1-5 *vs.* trials 6-10 on all measures. These scores are summarized in Table 2.

TABLE 2

MEAN TRANSFORMED SCORES ON THE FIRST FIVE AND LAST FIVE DAYS OF TESTING AND RELIABILITY OF MEASURES[a]

Test	Defecation			Ambulation			Latency to act			Grooming		
	1-5	6-10	r_{xx}	1-5	6-10	r_{xx}	1-5	6-10	r_{xx}	1-5	6-10	r_{xx}
Open field	2.06	1.85	.27	2.55	2.57	.45	1.13	1.00	.52	1.97	2.67*	.10
Closed runway	2.48	1.69*	.30	5.39	5.38	.50	.88	.88	.34	2.02	1.88	.34
Open runway	2.74	1.78*	.42	5.37	5.24	.63	1.25	1.12*	.65	1.56	1.93[c]	—
Dashiell maze	2.34	1.52*	.21	4.28	5.39*	.40				2.46	1.90*	.22
Water tank	2.66	2.46	.25									
Drinking cage							1.42	1.13*	.68	2.68	2.87[c]	—
Home cage emergence							.56	1.88[b]				

[a] based on single test session.

[b] number of sessions S emerged ($p < .05$).

[c] number of sessions S groomed.

* $p < .01$.

It can be seen that defecation decreased in all five test situations and latencies generally decreased upon repeated testing. Activity, however, increased in the Dashiell maze, showed a slight decrease on the open runway, and showed no measurable change on the remaining two measures. Similarly, grooming increased on three measures and decreased on two.

The analysis of repeated measures also allowed estimates of test-retest reliabilities to be computed for each of the measures. The values presented in Table 2 represent the reliability coefficients based on single test sessions. It can be seen that the greater frequency of significant effects on the defecation measure cannot be attributed to the reliability of this measure. Reliabilities of the ambulation and latency measures are consistently higher than those found with defecation and grooming scores.

Sex differences were found only on the open field defecation measure (males defecated more than females, $F = 6.8$, $df = 1/8$, $p < .05$) and the Dashiell maze activity measure (females were more active than males, $F = 5.3$, $df = 1/8$, $p < .05$).

Younger *S*s were found to be more active in the open field ($F = 17.5$, $df = 1/8$, $p < .01$), and on the open runway ($F = 6.1$, $df = 1/8$, $p < .05$). The latency measures on these two tests also indicated that young *S*s were faster to cross the first photo cell in the open field ($F = 9.5$, $df = 1/8$, $p < .02$), and that younger *S*s showed a greater decrease in latencies on repeated testing in the elevated maze than did older *S*s ($F = 2.6$, $df = 9/72$, $p < .02$). Younger *S*s also had significantly shorter latencies in time to begin drinking in the water deprivation test ($F = 88.2$, $df = 1/8$, $p < .01$), and they showed a higher incidence of grooming in the Dashiell maze than older *S*s ($F = 6.8$, $df = 1/8$, $p < .05$).

D. EXPERIMENT 3. FACTORS INFLUENCING ADAPTATION TO THE OPEN FIELD TEST

1. *Method*

a. Subjects and apparatus. *S*s were 48 Wistar rats of both sexes, born on shavings, weaned at 23 days, and given food and water *ad lib*. Twelve male and 12 female *S*s were 100 days of age at the beginning of treatment and the remaining 24 *S*s were 35 days of age. The animal room was on a 13-hr.-light/11-hr.-dark cycle and was maintained at a constant 76°-79°F temperature.

The shock apparatus consisted of a box, divided into four equal 10-in. × 7-in. compartments, with clear plastic front and lid and stainless steel grid floors. Each grid was wired independently to a 1150-vac shock source with a 1-megohm resistor in series with *S*. This apparatus produced a 1.0±.1 ma. shock to all *S*s.

The open field was 36 in. square with 24-in. flat black walls. The white plastic floor was marked with a 20-in. square in the center and was divided into four equal 18-in. quadrants by two photoelectric beams intersecting at right angles. When *S* crossed either beam a count was registered. This procedure eliminated the problem of observer bias in estimating ambulatory activity. The field was illuminated by one of three incandescent lamps suspended 18 in. above the center of the field. The brightest lamp provided an illumination of approximately 800 foot candles at the center of the field which gradually diminished to 80 foot candles near the walls. The medium lamp provided 400 to 40 foot candles and the dim bulb provided seven to .7 foot candles.

b. Design and procedure. Prior experience (undisturbed *vs.* preshocked), age (100 *vs.* 35 days), and sex were the three subject variables studied. The three illumination levels of the field were the fourth major factor. A 2 × 2 × 2 × 3 factorial design with two *S*s per cell resulted. *S*s which were preshocked received 20 one-second, 1-ma. shocks, spaced 30 seconds apart on the day before open field testing began. The remaining *S*s were not disturbed until testing began. At testing, *S*s were removed from home cages and within 20 seconds placed on one corner of the open field. The overhead light, in an otherwise darkened room, was immediately turned on and the photoelectric counters activated. *E* recorded the time taken by *S* to leave the corner and cross the first photocell beam and the number of "grooms" and number of fecal boluses during the five-minute test. At the end of the test period, the number of crossings of the photoelectric beam was recorded and *S* was returned to its cage. This procedure was repeated for 10 consecutive days.

2. *Results*

The transformations described in Experiment 1 were also used on these data. Since all trend effects were found to be monotonic in Experiment 2 and no major differences apart from overall trend effects occurred on adjacent days, the transformed scores for the first two days were averaged, as were the scores for days 9 and 10. These combined scores were respectively designated as the initial final exposures to the open field.

Table 3 presents an abbreviated summary of the analysis of variance of each of the four measures used. Only main factors and significant first order interactions are included, and all figures were rounded to one decimal place after computation.

a. Between-subject variables. Younger *S*s groomed more and defecated less

TABLE 3
SUMMARY OF SIGNIFICANT FACTORS IN THE ANALYSES OF VARIANCE OF OPEN FIELD BEHAVIOR

Source of variation	*df*	Defecation *MS*	Defecation *F*	Ambulation *MS*	Ambulation *F*	Latency *MS*	Latency *F*	Grooming *MS*	Grooming *F*
Between *S*s	47								
Preshock	1	7.6	3.8	.3	.1	.2	.4	.1	.0
Age	1	19.1	9.4**	.1	.0	.5	1.5	18.9	12.2**
Brightness	2	.9	.4	12.6	3.8*	2.5	7.5**	2.9	1.9
Sex	1	1.0	.5	28.7	8.6**	4.8	14.1**	2.3	1.5
Age × bright.	2	1.6	.8	23.7	7.1**	1.7	5.0*	2.1	1.4
Error between	24	2.0				.3		1.5	
Within *S*s	48								
Days	1	20.0	24.1**	5.7	2.2	.1	.2	3.2	31.6**
Days × preshock	1	13.2	15.9**	5.0	1.9	1.4	3.1	.8	8.2**
Days × age	1	2.2	2.6	14.5	5.5*	1.1	2.6	.2	1.7
Days × bright.	2	3.7	4.3*	1.3	.5	.2	.5	.9	8.5**
Error within	24	.8		2.6		.4		.1	

* $p < .05$.
** $p < .01$.

than older *S*s, but no significant overall age differences in ambulation and latency to leave the corner of the field were found. *S*s tested in the dim field were consistently more active and had shorter latencies than *S*s in the two brighter fields. Younger *S*s were more active than older *S*s in the bright field and less active in the dim field, producing significant age × brightness interactions on the ambulation and latency measures. Females were more active and had shorter latencies than males. Finally, administering shock prior to open field testing increased defecation ($p < .07$) but did not significantly affect other measures.

b. Repeated testing effects. As in Experiment 2, no significant change in ambulation or latency was found after repeated testing in the open field. The days × age interaction which did occur on the ambulation measure was due to increasing activity on the part of younger *S*s and decreasing activity by older *S*s. A summary of the effects of repeated testing on the defecation and grooming measures is shown in Table 4. As in Experiment 2, both measures showed a significant overall days effect, with defecation decreasing and grooming increasing after repeated testing. In addition, however, it can be seen that the days effect interacted with the preshock variable and also with the brightness of the field. The difference in defecation scores between preshocked and naive *S*s disappeared after repeated testing and *S*s tested in the bright field showed a greater drop in defecation after repeated tests than the remaining groups. Similarly, preshocked *S*s and those *S*s tested in the bright field significantly exceeded the overall days trend on the grooming measure.

TABLE 4
MEAN TRANSFORMED DEFECATION AND GROOMING SCORES ON INITIAL AND FINAL EXPOSURES TO THE OPEN FIELD

Experimental condition	Defecation Days 1 and 2	Defecation Days 9 and 10	Grooming Days 1 and 2	Grooming Days 9 and 10
Preshocked *S*s	3.7[a]	2.1	3.2[c]	3.8
Naive *S*s	2.4	2.2	3.4	3.6
7-foot candles	2.8[b]	2.2	3.2[d]	3.5
400-foot candles	3.1	2.4	3.3	3.4
800-foot candles	3.3	1.8	3.5	4.2

[a] SE difference between groups = .4, between days = .3.
[b] SE difference between groups = .5, between days = .3.
[c] SE difference between groups = .3, between days = .1.
[d] SE difference between groups = .4, between days = .1.

E. DISCUSSION

1. *Changes in Behavior in the Presence of Fear Eliciting Stimuli*

Results of Experiment 1 indicated that a conditioned fear stimulus increased defecation and latency scores and decreased ambulatory and grooming activity in all test situations. Only with the defecation measures, however, were the changes statistically significant in the majority of test situations sampled. Repeated exposures to the tests in Experiment 2 resulted in consistent decreases in defecation and latencies and mixed effects on ambulatory and grooming activity. The results of Experiment 3, which examined open field adaptation under a variety of conditions, were consistent with those of Experiment 2—defecation decreased and grooming increased, while no significant changes in ambulation or latency to cross the first photocell beam were found. In addition it was found that on their initial exposure to the field, *S*s which received prior shock and *S*s tested with the brightest illumination level respectively, defecated more and showed less grooming and ambulatory activity than naive *S*s and *S*s tested under dim illumination. Defecation increased in all cases when *S* was exposed to fear eliciting stimuli created through novelty, intense stimulation, or conditioning, and was the only behavior examined which showed consistency in all situations studied. Despite the variety of test situations employed, the results of the current experiments are in agreement with many previous studies examining specific aspects of the relationship between fear and defecation rates (e.g., 1, 3, 10).

Although *S*s appeared initially to remain inactive for a longer period of time in fear producing situations, differences in latency measures were rarely statistically significant. The current study provides weak support for using time to begin exploring in the open field as an index of fearfulness. The time required for *S* to emerge from its home cage did appear to reflect fearful behavior, since *S*s emerged significantly more frequently as they became familiar with the test situation and took significantly longer to emerge during CS presentations in Experiment 1. Various aspects of the consummatory response have been used as measures of emotional behavior, yet in the present study the CS did not significantly increase latency to begin drinking. Latency to drink did decrease upon repeated testing in Experiment 2 but the daily reinforcement in this test introduced a learning situation which confounds any interpretation in terms of fearfulness.

Despite the generally consistent decrease in ambulatory activity in the presence of the CS, novelty on bright illumination, the only significant changes were obtained in the Dashiell maze in Experiments 1 and 2 and in the brightly lit field in Experiment 3. It appears that a unidirectional change in ambulation, particularly in the open field, has at best weak support as an indication of fearfulness in rats. This may in part be due to the possibility suggested by Welkers experiments (17, 18) that some fearful *S*s may be attempting to escape from the open field, thus exhibiting a high activity level. Related to this is Whimbey and Denenberg's (19) conclusion that "emotional reactivity" is reflected by high activity on the first test session and low activity on succeeding sessions, and that "*S*s must be tested for a number of days . . . when attempting to give conceptual meaning to open field performance." Considering the questionable value of intersubject correlations for assessing measures of arousal and the small N ($N = 16$) in their experiment this argument loses force, particularly when satiation effects may confound the ambulation measure on repeated trials. In Experiment 2 of the current study low (.02 to .14) positive defecation-ambulation correlations existed on test days 1, 5, 7, and 10 and moderate (—.21 to —.55) negative correlations existed on other days. It would appear more reasonable to be wary of the use of open field ambulation as measure of emotional arousal in many circumstances.

The inference that there is some simple positive monotonic relationship between grooming and fear in rats is also questioned in the current experiments. The results of repeated testing in the open field are consistent with the earlier report of Doyle and Yule (4) indicating a gradual increase in grooming. One exception occurred in the maze in Experiment 2, where grooming decreased significantly upon repeated testing. A substantial increase in ambulatory activity occurred in this test and *S*s obviously cannot produce high scores on these competing activities simultaneously, thus, while grooming usually shows a decrease in frequency in threatening situations, it can also become secondary to a competing ambulatory response when an animal has little or no fear and also shows a decrease. This relationship between grooming and ambulatory activity is similar to that described by Fentress (5) working with voles *Microtus agrestis*. Immediately after a frightening stimulus *S*s groomed at a moderate rate and did not move about. Ambulation and grooming then increased gradually for a short period after which ambulation continued to increase and grooming decreased. It would appear then that the nonmonotonic relationship between grooming and fear at low levels of arousal limit the usefulness of this measure and may account for the lower grooming rates found in the Maudsley nonreactive strain (6).

Results of the present study imply that test situations that are highly fear provoking may be less sensitive to changes in fearfulness brought about through experimental treatment. The less noxious maze situation produced greater increases in defecation than the open field did when *S*s were subjected to fearful stimuli, and those tests in Experiments 1 and 2 on which defecation did not show significant changes were those on which defecation level was high without additional fear stimuli. It should be noted that Hunt and Otis (10) argued that defecation reflects emotional disturbances only when the reaction is quite strong, suggesting that rather bland test situations (including the open field) are not appropriate for testing emotional reactivity. The *S*s in this latter study were "rather phlegmatic Sprague Dawley *S*s," not affected intensely (in terms of defecation rate) by the open field. In the current experiments with Wistar rats, "bland" test situations were sufficient to invoke moderate to high defecation scores. This raises the disturbing possibility that the stimulus intensity of the test situation may have to be matched to the "autonomic reactivity level" of the subject population to be studied.

2. *Sex and Age Influences on the Tests*

In three test situations females were more active than males and several measures suggested that males were more affected by fear eliciting stimuli than females. The frequently reported finding that males defecate more than females in the open field was again found in Experiment 2. The failure to find sex differences on this measure in smaller areas and less noxious test situations suggests both that males may be more susceptible to intense fear stimuli and that some territory marking behavior is influencing the defecation score.

Age differences also appeared on several tests, with younger *S*s generally more active than older *S*s. Considering the tendency for younger *S*s to increase activity and older *S*s to show decrements upon repeated testing in Experiment

3, it is not surprising to find some inconsistencies in trend effects reported in the literature (2, 4, 14, 16).

3. *General Conclusions*

The behavioral measures examined in the above experiments have been frequently used by investigators as indices of emotionality or fear in rodents, despite the relatively weak evidence for the validity of these measures. In the present experiment situations involving the presentation of a conditioned fear stimulus, exposure to novel stimulation, and exposure to noxious stimulation were all examined with respect to the above behaviors. Only the defecation measure appeared to consistently change in the expected direction on the variety of test situations studied. Some relationships between emotionality and various activity, latency, and consummatory measures did seem to exist, but these appeared to be rather complex, often nonmonotonic, and situation dependent. While an investigator can operationally define any of the above behaviors to be a sign of emotion or fear, the fact that (*a*) there is relatively little correlation between these behaviors, and (*b*) changes in these behaviors do not necessarily correspond to that expected in situations generally considered to be fear producing, leads one to question the general usefulness of such arbitrary definitions.

F. SUMMARY

Three experiments examined the changes in several behaviors of 180 Wistar rats after fear conditioning and exposure to a variety of novel test situations. Frequency of defecation appeared to be the only dependent variable that showed consistent and predictable changes on all tests. The open field was a less sensitive instrument in which to measure changes in level of fear than a less noxious, more complex testing environment. Several difficulties arise when attempting to use ambulation, grooming, latency to respond, and consummatory behavior as indices of fear or "emotionality."

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LYSERGIC ACID DIETHYLAMIDE (LSD 25): XXXIX. THE EFFECT OF HIGH TEMPERATURES ON STABILITY*

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A. INTRODUCTION

Early reports indicated that LSD 25 was comparatively unstable. However, this laboratory, in conjunction with Loeb of the New York State Fish Hatcheries, showed that dissolved LSD 25 remained active as long as 16 days in the presence of fish kept in large fish tanks (3). Loeb also showed that if LSD 25 solutions were exposed to ultraviolet light, the rate of decomposition was accelerated.

For some years we have been studying the stability of LSD 25, using a biological assay method, with the surfacing reaction of fish as the criterion for drug activity (2). Extending the work of Loeb and his coworkers pertinent to stability, it has been found that LSD 25, in the absence of light, is remarkably stable even at high temperatures.

The effect of temperature on LSD 25 solutions is also important from another point of view. It has been proposed that LSD 25 be used in survival kits (1) to take advantage of the surfacing effect of this drug on certain species of fish; the effect, therefore, of cooking temperatures on foodstuffs containing LSD 25 is a paramount matter.

B. METHOD

1. *Fish Assay of LSD 25*

Ten goldfish, one to one and one-half inches in length, are placed in one-liter graduate cylinders (diameter = 6.4 cm), each of which contains one liter of distilled water. A slow steady stream of air is bubbled through each cylinder throughout the whole experiment. The water in the cylinders is brought to the same temperature as the room-temperature water in the tanks from which the fish are taken. In order to adjust to the altered environment, the fish are kept in the cylinders from 15 minutes to one-half hour, after which the LSD 25 is added and the surfacing of the fish observed. The ex-

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periments reported here lasted one hour and 10 minutes. The surfacing phenomenon is similar to that previously reported.

2. *Effect of 212° F*

Ten ml Pyrex test tubes, containing 3 mg of LSD 25 in 3 ml of distilled water, were closed with cotton plugs and immersed in water kept at the boiling point for one-half to four hours. Although the solutions of LSD 25 exposed to a temperature of 212° F for four hours showed a slight change in color (brownish tint), the assay of the presence of LSD 25 showed that, within the limits of error, very little of the LSD 25 was destroyed, or if any derivatives were formed, these derivatives were active and diffused through the gills of the fish. Figure 1 illustrates that with the fish assay method, no change in the action of the LSD 25 was observed.

3. *LSD 25 Biscuits Baked at 300° F: Reaction of Goldfish*

Biscuits prepared from a batter containing commercial Bisquick mix and tap water, divided so that each biscuit contained .5 mg LSD 25, were baked at 300° F for one hour. Similar biscuits were baked without addition of LSD 25, and these biscuits were used as controls in the fish assay experiments. After the biscuits were baked, they were allowed to cool and were stored in the freezing compartment of the refrigerator. The effect of the LSD 25 in the biscuits was observed on fish in two ways: in one series of experiments the biscuits were broken up in a Waring blender and the cloudy suspension of baked biscuit containing LSD 25 was tested directly on the fish. In a second experiment, the cloudy suspension of biscuit, after being broken up in the Waring blender, was filtered, and the relatively clear filtrate containing cooked LSD 25 was used on the fish.

The effects of baking at 300° F for one hour showed that, although the action on the fish was delayed, a large fraction of the LSD 25 remained active in both the filtered and cloudy biscuit solutions. This is illustrated in Figure 2. Note that although the action is delayed, after 30 minutes most of the fish have surfaced in both.

Neither the plain control biscuit solution nor the filtrate of the Waring blended control biscuits had any effect on the fish. When uncooked LSD 25 was added to a filtrate of the control biscuit, there was no change in the usual LSD 25 reaction on fish.

In other words, baking at 300° F in the presence of Bisquick batter either has destroyed not more than about 50 percent of the LSD 25, or else the LSD

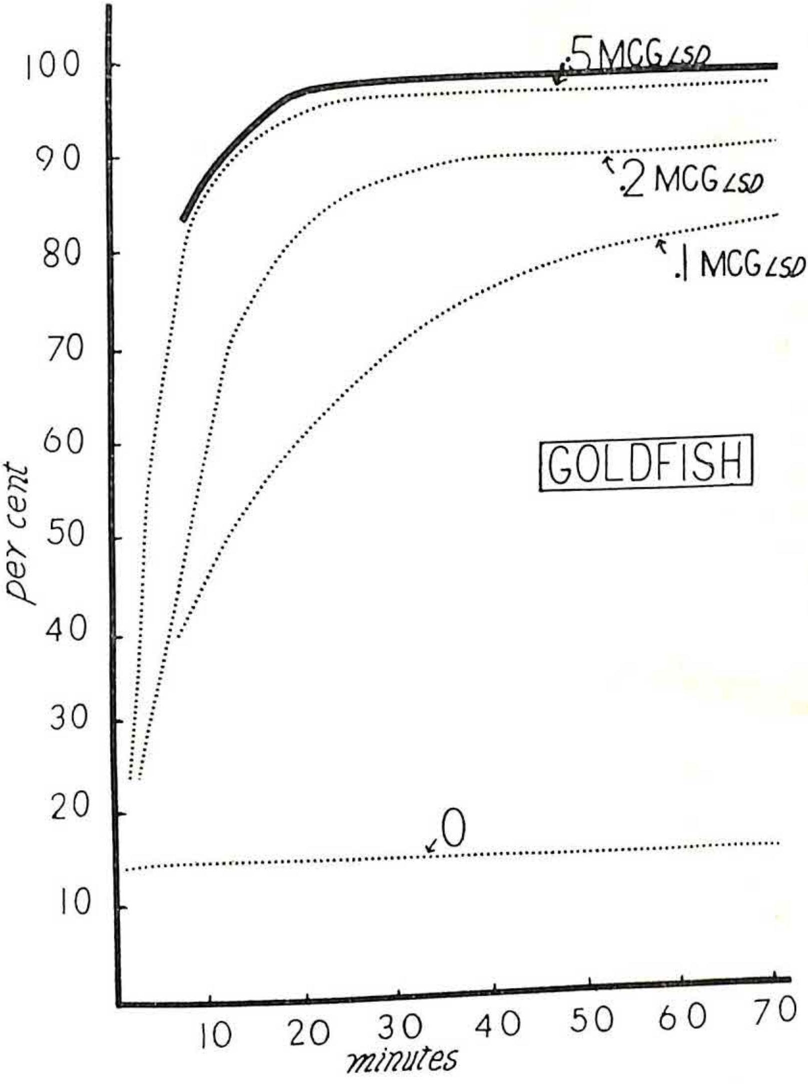

FIGURE 1

The ordinate values are the average percent of fish surfacing. The dotted lines represent standard curves for the surfacing of goldfish as a function of time in the presence of zero, .1 mcg, .2 mcg and .5 mcg per ml of uncooked LSD 25. The heavy continuous line, which follows the course of the effect of .5 mcg LSD 25, indicates that keeping a solution of LSD 25 at 212° F for four hours, as described in the text, does not decrease the effect of LSD 25 on the surfacing reaction.

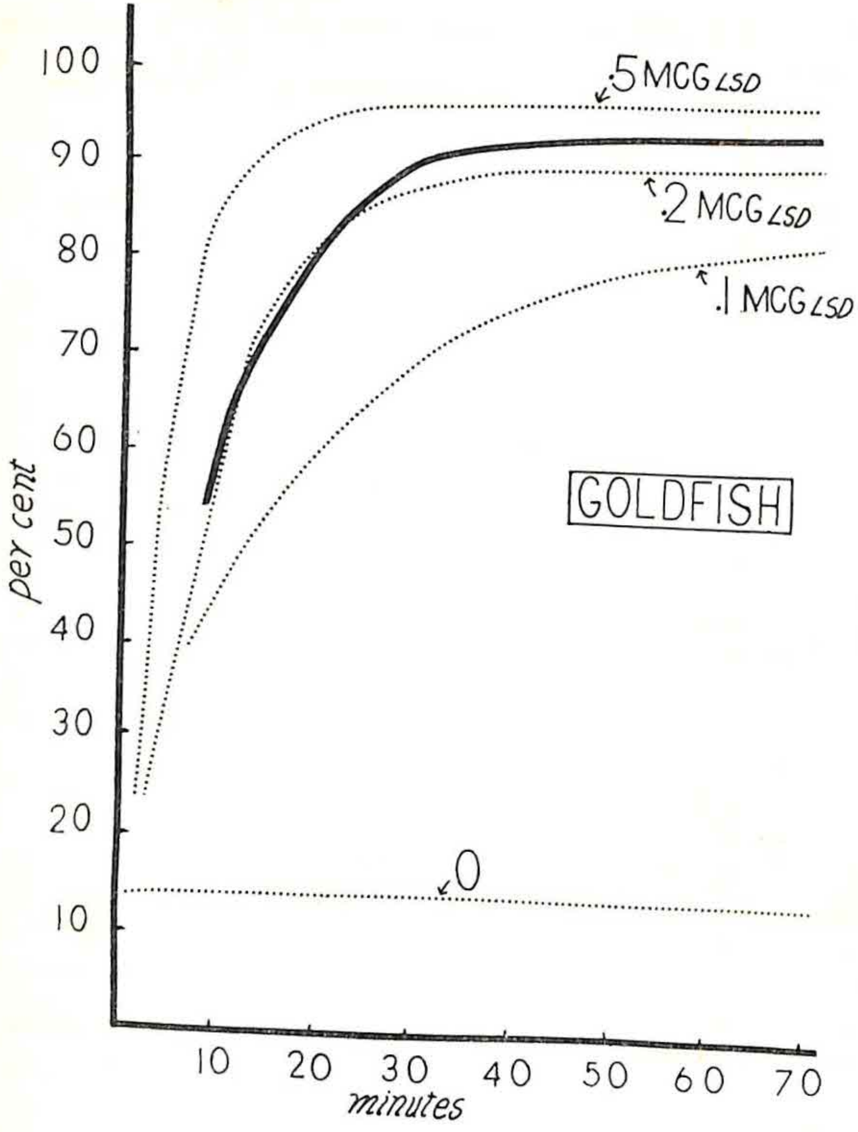

FIGURE 2

The ordinate values are the average percent of fish surfacing. The dotted lines represent standard curves for the surfacing of goldfish as a function of time in the presence of zero, .1 mcg, .2 mcg and .5 mcg per ml of uncooked LSD 25. The heavy continuous line, which terminates between .2 mcg and .5 mcg, shows the effect of baking LSD 25 in biscuit batter for one hour at 300° F. At least one-half of the LSD 25 remains effective.

25 has reacted with the batter components and its action is delayed. Since the data disclose that at least 50 percent of the LSD 25 remains active, it is evident that LSD 25 is not markedly destroyed by the baking process.

A most interesting correlated, and perhaps more pertinent, experiment was that performed with LSD 25 biscuits wrapped in aluminum foil and kept at room temperature for two weeks. There was apparently no further decrease in activity of the cooked LSD 25.

C. Discussion

In view of the traditional belief that LSD 25 is unstable, the experiments reported that show stability at high temperature, in the presence of farinaceous foodstuffs, must lead to the conclusion that these experiments should be expanded to other varieties of foods. For example, we have shown that small amounts of LSD 25 dissolved in the tank water produce surfacing of two and three pound carp, which can be readily used as food. If a large fish, like a two pound carp, absorbs LSD 25 through the gills, is the fish safe to eat? Another question of importance is concerned with the shelf-life of biscuits prepared with LSD 25. Our experiments extended only over a period of weeks. Will biscuits, baked with LSD 25, act as a preservative of LSD 25 and extend the shelf-life of LSD 25 over a period of years? To study this will be of utmost importance. Can the same thinking be applied to canned fish and meats, as well as other foodstuffs? The LSD 25 used in our experiments on fish was several years old and had begun to deteriorate. Would fresh LSD 25 show even greater stability during the baking process?

Another important area for research in this connection would be the comparison of the stability of congeners and derivatives of d-lysergic acid. For example, would MLD 41 (1-methyl d-lysergic acid) show as much retardation of effect as LSD 25? The presentation of these questions is not entirely academic. MLD 41, when ingested by man for about a week in increasing doses, produced an extraordinary tolerance to LSD 25. From the point of view of producing tolerance, it would be most important to study the stability of the numerous varieties of derivatives and congeners, especially as outlined in the paper by Loeb and his group (3).

D. Summary

Using the surfacing reaction of goldfish as a bioassay method, the effect of heat on the stability of LSD 25 was studied. Heating 1.0 mg per ml of LSD 25 at 212° F in the dark up to four hours did not lead to an appreciable de-

struction of the LSD 25. Baking the LSD 25 in a batter made from commercial Bisquick at 300° F for one hour and freezing for several weeks led to some destruction of the LSD 25, but at least 50 percent of the LSD 25 remained active.

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ON THE USE OF PARAMETRIC STATISTICAL TECHNIQUES TO ASSESS THE ON-OFF CHARACTERISTICS OF SPEECH*

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A. INTRODUCTION

Researchers interested in the time patterns of speech have employed various measures of its on-off characteristics, among them; on (sound) and off (silence) distributions (1, 9), the means of these on-off distributions (3), and the apparent rhythmic properties to be found in the lengths of successive periods of sound and silence (6, 8). Jaffe *et al.* (11) have proposed a mathematical model to account for the on-off sequence in monologue and have defined the parameters thereof. These parameters are the conditional probability of speaking given previous silence (q_0), and the conditional probability of speaking given previous speech (q_1).

The on-off properties of speech have been extensively investigated, mainly in the quantification of delayed auditory feedback effects (14). The most commonly used measures of these temporal characteristics are total phonation time, percent phonation time, and total pause time (14). Investigators have taken for granted that the underlying distributions of these variables are essentially normal, and have consequently employed parametric statistical techniques to assess the various experimental effects.

While data with respect to intensity of speaking has been presented which shows that the instantaneous pressures of sound are approximately normally distributed (4, 13), no such data have been presented in the literature regarding the normality of the distributions of those variables which are referable to the temporal characteristics of spontaneous speech. Particularly, since Brady (1) and Jaffe (9) have shown that for durations of speech equal to or greater than 200 msecs. an individual's distribution of sound and of silence are exponentially distributed, it then follows that measures, such as total pause and total phonation time, and mean pause and mean phonation time, represent the sums and means, respectively, of exponential distributions. The question now arises as to what distribution characterizes these sums and means.

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Specifically, this paper will determine whether the use of parametric statistics is indicated with respect to variables of total phonation time,[1] mean phonation time, mean pause time, and the related conditional probabilities of speaking (q_0 and q_1),[2] in two monologue speaking conditions.

B. METHOD

Monologue data from a previous experiment (5) were reanalyzed for the present investigation. Twenty-five male and 25 female applicants to a psychotherapy clinic spoke in two different speaking conditions of five minutes each, with condition A being speech in response to TAT cards, and condition B being speech on a topic of personal interest. An analogue to digital converter (2) and PDP 8/I computer were used to process the data. The system sampled speech at 200 times per minute, indicating for each sample whether there was a sound or a silence. With the use of this system, it was possible to obtain the distributions of runs of both on and off periods, and the conditional probabilities of speaking.

In order to determine whether the various temporal measures are normally distributed, a chi-square technique was used (7). That is, for any of the temporal measures considered, the observed distribution of the 50 *S*s was compared to a theoretical distribution based upon an underlying assumption of normality of the 50 *S*s.

C. RESULTS

The results of the chi-square analysis are shown in Table 1. Total phonation time, mean phonation time, and q_0 are normally distributed for both speaking conditions, while q_1 is normally distributed in condition B.

TABLE 1
CHI-SQUARE VALUES FOR TEST OF NORMALITY ON 50 SS FOR VARIOUS TEMPORAL MEASURES, UNDER TWO SPEAKING CONDITIONS

Speaking condition	Total phonation time	Mean pause time	Mean phonation time	q_0	q_1
A	4.8	45.9*	10.4	9.6	22.2*
B	4.0	32.6*	11.6	5.6	5.6

* Significant at the .05 level.

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[1] Since all speech samples in the present experiment were exactly five minutes, measures of percent phonation time, total phonation time, and total pause time, will all give identical results. Thus, for brevity, we will use the measure of total phonation time to describe all three.

[2] For monologue, q_0 is directly derivable from mean pause time, and q_1 is directly derivable from mean phonation time.

D. DISCUSSION

The results have shown that mean pause time and q_1 (under condition A) showed a distribution of scores which departed significantly from normality. Ramsay (12) using tasks of reading and response to TAT cards (equivalent to condition A), observes that scores of mean pause time and mean phonation time are not normally distributed. However, it should be noted that reading is clearly not spontaneous speech, and that speech in response to TAT cards makes special demands upon the subject, requiring longer periods of pausing to interpret and respond to the stimulus. Consequently, condition B is most relevant to spontaneous speech and only the measure of mean pause time is not normally distributed under this condition.

This research has investigated a fundamental property in the use of various metrics—namely, their underlying distributions. Prior to using a metric to describe a process, certain basic questions must be answered. In previous research (10), we have determined that with respect to the temporal patterns of speech, a five-minute sample will give reliable measurements. The present investigation has addressed itself to the nature of the underlying distribution of the measures which describe these patterns. The results have shown that under spontaneous speaking conditions it is appropriate to use parametric statistical tests on metrics, such as total phonation time, mean phonation time, and the conditional probabilities of speech.

E. SUMMARY

Various measures have been employed to assess the on-off patterns of speech, yet practically no research has been reported on the nature of their underlying distributions. Sampling five minutes of speech at 200 times per minute, the distributions of 50 *S*s' scores on measures of total phonation time, mean phonation time, mean pause time, and the conditional probabilities of speech were subjected to a chi-square test of normality. The results indicated that under a spontaneous speaking condition, only mean pause time was not normally distributed.

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CRITICAL FLICKER FREQUENCY AND INTEGRATIVE FUNCTIONS IN PARKINSONISM*[1]

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A. INTRODUCTION

Critical flicker fusion (CFF) depends on many factors relating to the physical characteristics of the light source as well as on the physiological and psychological status of the observer. Several reviews have summarized research in this area (2, 7, 10, 12, 15), and although both peripheral and central nervous system components have been found relevant to CFF, cortical factors are thought by many investigators to be the decisive ones (1). Brain lesions, such as occipital lobe injuries, temporal lobectomy, brain tumors, multiple sclerosis, paresis, cerebrovascular disease, and other pathologies of the brain, decrease CFF significantly (3, 4). Moreover, CFF declines with age (10). The accumulated data suggest that the CFF can be used as a useful behavioral correlate of what has been described, among other things, as "overall cerebral functioning" (6). These data have obviously meaningful implications for both psychology and neurology.

The foregoing considerations constituted the basic rationale for the selection of the Flicker-Fusion Test in the psychological assessment of parkinsonians. A further reason was Lindsley's finding that "flicker-fusion rate of individual cortical neurons can be raised considerably by thalamic or reticular stimulation" (9, p. 1579). The specific purpose of this study was to determine whether parkinsonians, with largely subcortical involvement, show alterations in CFF as a function of possible changes in "integrative" behavior.

B. METHOD

1. *Subjects*

Subjects consisted of 37 parkinsonians with either predominantly left or right hemisphere involvement, and 13 patients with cardiovascular diseases.

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For the cardiovascular patients, the history and findings of the medical and neurological evaluations were reviewed for evidence of "organic mental changes." In no case was there any sign to indicate the presence of cognitive or behavioral alterations usually associated with so-called "organicity." These patients thus represented a "nonneurological" group with physical and environmental limitations similar to those of parkinsonians and appeared suitable for purposes of comparison. Table 1 presents data on age, education, and length of illness for the parkinsonian and cardiovascular groups.

TABLE 1
AGE, EDUCATION, AND LENGTH OF ILLNESS FOR PARKINSONIANS AND CARDIOVASCULAR PATIENTS

Subjects	Number	Sex M.	Sex F.	Mean Age	Mean Educ.	Mean Length of Illness
Parkinsonians with left hemisphere involvement	20	12	8	57	12.7	6.0
Parkinsonians with right hemisphere involvement	17	11	6	59.3	10.1	5.1
Cardiovascular patients	13	9	4	51.3	11.1	4.4

On the basis of *t*-tests, no significant differences at the $p < .05$ level were found between the parkinsonian groups with regard to sex distribution, age, education, or length of illness. The cardiovascular and parkinsonian groups were equated with respect to sex distribution and mean education. However, mean age and length of illness were lower in the case of the cardiovascular patients.

2. *Instruments*

A test battery consisting of the Flicker-Fusion test, a Tapping test, the Graham-Kendall test, the Object Naming test, and the Identical Pictures test was administered individually to all subjects. These tests were selected to assess several cognitive and perceptual functions, through both verbal and nonverbal mediation. For the Flicker-Fusion test, an electronic flicker apparatus, constructed by the International Applied Science Laboratory, was used to present the light stimuli. This unit incorporated a variable frequency oscillator, designed to produce a square wave signal at frequencies between 10 and 90 cycles per second (cps). The light source was a Sylvania glow modulator tube (R1131C) inserted behind a circular milk glass test patch 12.5 mm in diameter. This source sustained a visual angle of two degrees when viewed monocularly through an artificial pupil two millimeters in diameter. Stimulus intensity was held constant throughout testing. A 1:1 light-dark ratio was used. Built-in timers were set to present the flickering light for five seconds, followed by a five-second off-interval. Monocular CFF thresholds were obtained for the right and left eye separately. The method of limits was employed proceeding in two cycles per second steps. Alternately, two ascending and two descending runs were given. The subject's CFF threshold was the arithmetic mean in cps of the thresholds obtained in the four runs.

The four other tests administered to the patients were as follows:

a. Speed of Tapping. In this task, the patient was given a stylus and required to alternate taps between two metal plates, placed 11 inches apart.

b. Graham-Kendall Memory-for-Designs Test. The 15 designs of the Graham-Kendall Memory-for-Designs were shown to and reproduced by subjects according to standard instructions.

c. Object Naming. This test required a subject to name as many specific objects falling within a group or category of objects as quickly as possible.

d. Identical Pictures. In this test, on one and the same line, a series of five designs and a sample design were presented to the subject. Selection of the matching figure from a series of five designs presented with the stimulus design was the object of the task.

For the parkinsonians rigidity and/or tremor were evaluated by means of a five-point scale, with zero corresponding to the absence of rigidity and/or tremor and four denoting the greatest degree of rigidity and/or tremor. For tremor and rigidity interrater reliabilities of .88 and .92 respectively, significant beyond the $p = .01$ level, were based on 16 parkinsonians. A voluntary movement index was calculated based on the proportion of functional activities which could be carried out independently. This proportion was derived from the summed ratings of a 15-item scale. Autonomic nervous system malfunction was derived from a nine-point scale. The items included such symptoms of autonomic malfunction as hyperhydrosis, hypersalivation, and tachycardia. High scores corresponded to relatively marked autonomic malfunction. Interrater reliabilities for ratings of voluntary movement and autonomic malfunction based on 16 patients with Parkinson's disease were .92 and .61, significant beyond the .001 and .01 levels, respectively.

C. RESULTS

Initial statistical analysis (*t*-tests) compared parkinsonians with cardiovascular patients on flicker function for the right eye, the left eye, and the right-left eye mean score. In no instance were any significant differences found at or near the $p < .05$ level. In like manner, comparisons on CFF scores were made between parkinsonians with primarily left brain involvement and those with primarily right brain involvement. The criteria for left and right brain "involvement" were based upon clinical ratings of which side of the body presented a greater degree of tremor and rigidity. It was then presumed that the opposite cerebral hemisphere was mainly affected by the disease process. No statistically significant differences were found at the $p < .05$ level as a function of laterality of predominant involvement between CFF scores for the left eye, right eye, or right-left mean scores (left eye t value $= .33$; right eye t value $= 1.08$; right-left mean t value $= .73$).

To determine the relationship, within the parkinsonians, between CFF performance, neurological parameters, and personal history variables, 24 Pearson product-moment correlations were derived. Specifically, CFF scores for the right eye, left eye, and right-left mean were correlated with age, education, length of illness, severity of symptoms, autonomic nervous system involvement, and impairment in functional activities of daily living for 37 preoperative parkinsonians. The major relationship between flicker function and the pattern of personal and neurological variables was a significant negative correlation between flicker performance for the left eye and the right-left eye mean, and symptom status ($r = -.43$, $p < .01$; $r = -.37$, $p < .05$, respectively). Patients with more severe symptom presentation performed less adequately in flicker function than those with less marked involvement. Impairment of autonomic nervous system function was also inversely correlated to flicker performance, but only for the left eye ($r = -.34$, $p < .05$). Finally, within the relatively narrow limits of these groups of patients, age did not correlate with reduced flicker function, as previously reported for groups with a greater range in age distribution (11).

The relationship of CFF performance to scores obtained by parkinsonians on other psychological tests of psychomotor, perceptual, and verbal functions is shown in Table 2.

Performance on flicker function was related to all other psychological tests. Among the more salient relationships were positive correlations between tapping performance for the left hand and flicker function, suggesting that the lower the tapping rate, the less efficient the flicker performance. Significant

TABLE 2
CORRELATIONS OF CFF SCORES WITH PSYCHOMOTOR, PERCEPTUAL, AND VERBAL TEST PERFORMANCE IN PARKINSONIANS
($N = 37$)

CFF	Tapping Right Hand	Tapping Left Hand	Graham-Kendall	Objects-Plants	Identical Pictures
Right eye	.21	.34*	—.36*	.25	.39*
Left eye	.35*	.45**	—.50**	.51**	.36*
Right-left mean	.31	.45**	—.46**	.42*	.39*

* $p < .05$.
** $p < .01$.

correlations with Identical Pictures, Object Naming Plants, and Graham-Kendall performance indicate that lowered CFF function is related to decreased efficiency on each of these tests.

D. DISCUSSION

Although the parkinsonian is said to demonstrate degenerative changes in various subcortical structures and possibly in cortical structures as well in the more advanced cases (5), no differences were present in CFF performance when parkinsonians were compared to individuals suffering from cardiovascular disease. The implications of such a finding appear all the more rather salient, since many of the cardiovascular patients demonstrated shorter lengths of illness and were younger in age. This disparity may be due in part to the nature of the parkinsonian group under consideration. For example, in previous related studies (8, 13), no significant differences in a variety of "integrative" functions were found between parkinsonians and equated groups of normals, arthritics, and cardiovascular patients. From such studies, it was previously concluded that parkinsonian groups need not be considered "organic" in the psychological sense of the term. Using flicker function as a criterion, the present findings suggest that this sample of parkinsonians may show little or no behavioral evidence of "cortical" involvement, since the weight of current concepts concerning the mechanism of flicker function indicates a cortical prepotency (1). In contrast, the significant relationship between lowered flicker performance and such neurological variables as symptom severity and autonomic nervous system involvement suggested that, although the total parkinsonian sample is not significantly impaired in "neurological efficiency," a relationship does obtain between a more advanced disease process and reduced effectiveness in this function. This particular finding corroborates previous reports of significant relationships between impairment in "integrative" psychological functions and severity of disability, neurological rigidity, and autonomic nervous system involvement (14). This result is also compatible with earlier studies which suggested a significant relationship between lowered CFF performance and increased neurological involvement (6).

Finally, the relationship between flicker function and performance in several other psychological tests, including those involving psychomotor speed and efficiency, and spatial as well as verbal performance, suggests that flicker function is indeed related to other "integrative" behaviors, which in turn correlate with "cerebral efficiency."

E. Summary

Parkinsonians were given the Critical Flicker Frequency Test and tests of psychomotor performance, perception, perceptual memory, and verbal functions. They did not differ on any of the variables from cardiovascular patients. However, within the parkinsonians, significant relationships were found between reduced flicker performance and increased neurological impairment and between reduced flicker performance and lower scores on the other psychological tests. Reduced cerebral efficiency, as determined by increased neurological involvement, seems related to reduced flicker performance. The findings also suggest a possible subcortical component for the neural mechanisms which contribute to flicker performance.

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THE EFFECT OF REVERSAL OF PREMISES ON CHILDREN'S DEDUCTIVE REASONING ABILITY* [1]

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James J. Roberge

A. Introduction

In many experimental studies formal logic has been used as the mechanism for studying the deductive reasoning ability of adults. For the most part, syllogisms have been used as the experimental tool, since many psychologists believe that "the rules of the syllogism describe processes that the mind follows in deductive reasoning . . ." (7, p. 377). The results of these studies indicate that the syllogistic reasoning ability of adults is distorted by (*a*) the use of abstract and unfamiliar materials (18), (*b*) similarities in the logical form of the premises and the conclusion—i.e., "atmosphere effect" (1, 13, 16, 19), and (*c*) personal convictions and attitudes about the content of the syllogisms (3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 17). Some of these findings have been replicated recently in experimental studies involving school-age children (2, 10, 15).

The present investigation evolved from a scrutiny of the findings of experimental studies conducted by Sells (16) and Chapman and Chapman (1). Specifically, in both studies there was a remarkable consistency in adults' abilities to reason with syllogisms which differed only in the order of the major and minor premises. The present investigation represented an attempt to determine whether or not these results would recur with school-age children (ages 9-18). The general problem to which this investigation was directed was: "Does reversal of premises have a significant effect on children's abilities to reason with principles of class reasoning and their isomorphs in conditional reasoning?" Specific questions to which this investigation suggests answers are:

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[1] Adapted from the author's PhD dissertation which was completed at The University of Connecticut under the direction of Drs. Ellis B. Page, Dieter H. Paulus, and Robert A. Shaw.

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(a) Do children's scores on deductive reasoning items containing reversed premises differ significantly from those not containing reversed premises?

(b) Do children's scores on deductive reasoning items containing reversed premises and those not containing reversed premises differ significantly at various grade levels?

(c) Do children's scores on deductive reasoning items containing reversed premises and those not containing reversed premises differ significantly for class and conditional reasoning?

To answer these questions, subjects were asked to judge the *truth* of conclusions of deductive arguments in class and conditional reasoning. Suffice it to say, for the present, that class reasoning deals with propositions of the form "All A's are B's," whereas conditional reasoning involves propositions of the form "If A, then B." Moreover, subjects were presented with an equal number of items containing premises in natural order and in reverse order.

B. METHOD

1. *Subjects*

A total of 263 subjects were tested during this investigation. These subjects were members of 13 classes which were selected randomly from three public school systems in southeastern Connecticut. A random sample of 228 subjects (57 at grades 4, 6, 8, and 10) were selected for further analysis.

2. *Procedure*

Three tests were administered to each subject. These tests evaluated the subject's ability to reason with six basic principles of class reasoning and their isomorphs in conditional reasoning. The tests used to evaluate the subject's class reasoning ability were the *Paulus-Roberge Class Reasoning Test* and the *Paulus-Roberge Class and Conditional Reasoning Test.* Those used to evaluate the subject's conditional reasoning ability were the *Paulus Conditional Reasoning Test* and the *Paulus-Roberge Class and Conditional Reasoning Test.* The *Paulus Conditional Reasoning Test* was constructed by Paulus (14); the other two tests were developed in a pilot study prior to the beginning of this investigation.

The order of administration of the tests was randomly varied, by class, in an attempt to counterbalance test wiseness or any other reactive effects that the taking of one test might have on subjects' scores on subsequent tests. To measure the effect of reversal of premises, the major and minor premises of those principles containing two premises—i.e., principles one through five—

were reversed. For principle six—i.e., contraposition—the major premise and the conclusion were reversed. Table 1 illustrates examples of items containing reversed premises for each of the principles of class and conditional reasoning. It should be noted that the content of all of the items was concrete-familiar to reduce the confounding effect of other variables. That is, these items contained conclusions which stated *facts* not within the subjects' experiences; e.g., "The puppy belongs to Nancy."

TABLE 1
ILLUSTRATION OF BASIC PRINCIPLES WITH REVERSED PREMISES

Principle	Class reasoning	Conditional reasoning
1	The radio is broken. All broken radios make a buzzing noise. ∴ The radio will not make a buzzing noise.	The phonograph is broken. If the phonograph is broken, then it will make a loud noise. ∴ The phonograph will not make a loud noise.
2	This kitten is gray. All of the kittens that belong to Rose are gray. ∴ This kitten belongs to Rose.	The puppy is brown. If the puppy belongs to Nancy, then it is brown. ∴ The puppy belongs to Nancy.
3	The door bell is not ringing. All door bells that ring are noisy. ∴ The door bell is not noisy.	The telephone is not ringing. If the telephone rings, then you have to answer it. ∴ You do not have to answer it.
4	The picnic will not be called off. All cold days the picnic will be called off. ∴ It is not cold today.	The game will not be called off. If it rains, then the game will be called off. ∴ It will not rain.
5	All useful pencils have lead. All of Ed's pencils are useful. ∴ All of Ed's pencils have lead.	If you may use the pencil, then you may also use the pen. If the pencil is red, then you may use it. ∴ If the pencil is red, then you may use the pen.
6	All of the ball pens that do not have any red ink will not write. ∴ All of the ball pens that write have red ink.	If the pen does not have any red ink, then you can not write with it. ∴ If you can write with the pen, then it has red ink.

3. *Design and Analysis*

A 4 × 2 × 2 factorial design (fixed factors) with repeated measures on the last two factors was used; Factor 1: fourth, sixth, eighth, or tenth grade; Factor 2: class or conditional reasoning; Factor 3: reversed premises or natural order.

The dependent variable in the analysis was subjects' scores on the concrete-

(a) Do children's scores on deductive reasoning items containing reversed premises differ significantly from those not containing reversed premises?

(b) Do children's scores on deductive reasoning items containing reversed premises and those not containing reversed premises differ significantly at various grade levels?

(c) Do children's scores on deductive reasoning items containing reversed premises and those not containing reversed premises differ significantly for class and conditional reasoning?

To answer these questions, subjects were asked to judge the *truth* of conclusions of deductive arguments in class and conditional reasoning. Suffice it to say, for the present, that class reasoning deals with propositions of the form "All A's are B's," whereas conditional reasoning involves propositions of the form "If A, then B." Moreover, subjects were presented with an equal number of items containing premises in natural order and in reverse order.

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The dependent variable in the analysis was subjects' scores on the concrete-familiar items containing reversed premises and those *not* containing reversed premises. Since there were four items of each type per principle of class and conditional reasoning, the possible range of a subject's score for each cell was 0-24.

The summary table for the analysis of variance is presented in Table 2 and the corresponding cell means and standard deviations are presented in Table 3.

TABLE 2
ANALYSIS OF VARIANCE FOR GRADE LEVELS, TYPES OF REASONING, AND REVERSED PREMISES

Source of variation	Degrees of freedom	Mean square	*F*
Between Subjects	227		
Grade Levels (G)	3	1238.48	47.13*
Subjects within groups	224	26.28	
Within Subjects	684		
Types of Reasoning (T)	1	35.50	8.28*
G × T	3	45.02	10.51*
T × subjects within groups	224	4.29	
Reversed Premises (R)	1	10.12	2.16
G × R	3	4.54	<1
R × subjects within groups	224	4.69	
T × R	1	1.75	<1
G × T × R	3	6.15	1.62
T × R × subjects within groups	224	3.80	

* $p < .001$.

TABLE 3
CROSS TABULATION OF MEANS AND STANDARD DEVIATIONS FOR ANALYSIS OF VARIANCE

	Reversed Premises					
	Yes		No		Combined	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
Grade Level						
4	10.76	2.95	10.91	3.48	10.84	3.22
6	10.39	3.00	10.90	3.31	10.65	3.16
8	13.58	2.75	13.90	2.81	13.74	2.78
10	15.52	3.44	15.37	3.32	15.45	3.37
Combined	12.56	3.70	12.77	3.77		
Type of Reasoning						
Class	12.80	3.95	12.93	3.80	12.87	3.88
Conditional	12.32	3.41	12.62	3.73	12.47	3.57
Combined	12.56	3.70	12.77	3.77		

C. Results and Discussion

The *F* ratio (see Table 2) associated with the main effect Reversed Premises suggested that the answer to the question of whether reversal of premises had a significant effect on children's deductive reasoning ability was "No." That is, reversal of premises did not alter the difficulty of the deductive reasoning items for the subjects tested in this investigation. This result is concordant with those reported by Sells (16) and Chapman and Chapman (1) in their investigation of the syllogistic reasoning ability of adults.

The *F* ratio (see Table 2) for the Grade Levels × Reversed Premises interaction term suggested that the answer to the question of whether reversal of premises had a significant differential effect at various grade levels was "No." An examination of the first part of Table 3 reveals that when types of reasoning were combined the means for the items containing reversed premises were slightly smaller than the means for those not containing reversed premises at all but the tenth grade. This finding was surprising. Specifically, it was anticipated that at lower grade levels (grades 4 and 6) reversal of premises would have a marked effect on children's deductive reasoning. However, the results showed that differences between the means at lower grade levels were remarkably similar to those at upper grade levels. In other words, the ability to organize propositions in a logical sequence manifests itself in children's thinking as early as the fourth grade (ages 9-10).

Finally, since the *F* ratio (see Table 2) associated with the Types of Reasoning × Reversed Premises interaction term was also less than unity, the suggested answer to the question of whether reversal of premises had a significant differential effect according to the type of reasoning was "No." Again, the means (see Table 3) were remarkably similar when grades were combined with the means for items containing reversed premises and those containing premises in their natural order both being slightly larger in class reasoning. This consistency across types of reasoning has important psychological and pedagogical implications.

D. Summary

The subjects in this investigation were 228 school-age children (ages 9-18). The investigation concerned the effect of reversal of premises on children's deductive reasoning ability at specific grade levels (grades 4, 6, 8, and 10) and for two types of reasoning (class and conditional). The obtained results indicated that reversal of premises had a negligible effect on the development of children's deductive reasoning ability. These findings have important implications for developmental theories of learning.

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E. G. BORING AND THE *ZEITGEIST*: *ERUDITIONE GESTA BEAVIT** [1]

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SAUL ROSENZWEIG

On July 1, 1968, in the 82nd year of his life, Edwin Garrigues Boring passed into history. He was born on October 23, the day of the month after the day that was called Fechner Day at his Harvard Laboratory. For on the morning of October 22, 1850 the father of psychophysics, still in bed and passing from the realm of dreams to that of waking consciousness, was inspired with the insight that developed into the Weber-Fechner Law. Boring and his confreres of the Laboratory informally commemorated Fechner Day annually, and one may safely speculate that the birthday of the celebrated historian of experimental psychology could not have been far below the collective threshold on those occasions.

I had first learned of Boring's fatal myeloma through a letter early in 1967 from Harry Murray in which he imparted this diagnosis together with the information that Boring was at the Stillman Infirmary. In late April I visited him there and talked with him for the last time. He glowingly described the party for his 80th birthday, a few months earlier, when Smith Stevens, acting for the group, presented him with a commemorative plaque. His characteristic bouyancy was much in evidence and he held forth ("since you are interested . . .") on the prospects of successful treatment through a new drug, discovered too late to save his sister who had died of the same malady, but now available to help him. I departed on this note that seemed to cheer us both. Before leaving Cambridge I had discovered that Gordon Allport was also at the Infirmary and, though it was too late to visit, I did talk with him by telephone. By October he had died of lung cancer. During that same trip I spent an evening with Harry Murray at the Spouter Inn. All in all, it was a memorable round of visits that revived the poignant memory of many beginnings.

When as an undergraduate dreamer I began to explore the transcendental regions of Emerson Hall, I willy-nilly became part of a Divine Comedy at

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Harvard. As a most minor Dante, I was introduced to Inferno, Purgatorio, and Paradisio, and it was fated that as a senior in 1928 my guiding Virgil should be a Prince named Morton, founder of the Harvard Psychological Clinic. Though he joined the company of shades the next year, a month after I received my baccalaureate, I was privileged to hear some of his last lectures. For 20 years he had been the renowned exponent of the three personalities of Miss Beauchamp, which, in a flippant moment, he christened the Devil, the Woman, and the Saint. I later came to recognize these same three essences in Freud's Id, Ego, and Superego. But at the time it was this multiple personality in prototype that I was destined to explore, not in a neat sequential order, as did Dante, but by fits and starts, like the Jabberwocky. For during my ensuing graduate years I had three separate and simultaneous guides. There was Harry Murray for the realm of the chaotic and creative Id; there was Gordon Allport for the functionally autonomous Ego; while for the commanding and demanding Superego, at the top of Emerson Hall, there was E. G. Boring. Because I was—and still am—an idiopathic eclectic, I appreciated all three, idiodynamically, not only then but for all the following years. Thus, for better or for worse, my hejira has been complicated and enriched by a triple allegiance. Today, however, it is to EGB that tribute is due. It will honor him best to recall his conspicuous devotion to candor and to proceed under the guideline *nil nisi verum*.

It would be pleasant to recall the various contacts that I enjoyed with Boring, personally and by correspondence, over a period of 40 years. In particular, I could happily describe our tentative joint efforts to encourage the APA to establish a museum of living psychology—a museum that might at this juncture so fittingly be started as a memorial to *him*. Alternatively, it would be possible to review Boring's numerous accomplishments and contributions. But for present purposes it is more appropriate to single out one idea—one concept—that is closely tied to his name and that will offer an opportunity to view him as a creative individual, creating out of his need, his interest, and his best abilities. That concept is the *Zeitgeist*.

A word or two regarding the history of the term *Zeitgeist* is appropriate. Boring was aware that Goethe used it, and he apparently believed that it was first coined by the sage of Weimar (8, p. 101). Actually *Zeitgeist* dates back to at least 1789 when another German, Lenhart Meister, employed it in a short history concerned with the early days of the French Revolution (16). It occurred in a book by Lavater a bit later and was frequently employed by Herder, the influential historian of human development and culture. Not improbably Goethe derived the term from Herder during the days of their intimate friendship. So *Zeitgeist* has in its origins some connection with civil and military history, with humanistic history, and with aesthetics. But it was Matthew Arnold, aware of Goethe's usage, who gave the word currency in English. For him the term played a central part in the history of the religious life, an area in which he applied it from 1863 onwards. In his widely read *Literature and Dogma* of 1873 (1), the term was exploited and fed into the language. It is of interest that while Boring seemed not to be aware of the use of the term before Goethe, he did, at least once (9, p. 191), cite Arnold's influence in giving it currency. It is a plausible conjecture that he first encountered it not in Goethe's obscure and untranslated 1827 note (15) on Homer but in the writings of Arnold, who was well known in the last quarter of the 19th century as a humanistic critic of literature and the moral life. But other critics have belabored Arnold for using *Zeitgeist* as a "fetish, a talisman" (13, p. 174) or, again, as a will-o'-the-wisp that "misleads . . . as much as it enlightens" (17, p. 103). And a recent reviewer (20) of all these criticisms, examining the matter in the light of Arnold's various uses of the term, concludes that Arnold never did have a single and clear definition of it, and that in his essays on religion it served the rhetorical purpose of suggesting without proof that "the wisdom of man is ultimately the wisdom of God" (*ibid.*, p. 996).[2]

A comprehensive survey of Boring's usage would cover his own anticipation of himself in 1927 (3), the first incidental appearance of the *Zeitgeist* in 1942 (6), its detailed exploitation in the second edition of *A History of Experimental Psychology* in 1950 (7), his popular exposition of its dual role in 1955 (8), and the definitive statement in his Presidential address to the International Congress of Psychology in Washington in 1963 (11).

The first suggestion of the concept is found in a paper entitled "The Problem of Originality in Science" (3). In it he described a series of independent discoveries in physiological psychology. He attributed these coincidences to the continuous development of science and the importance of the readiness of the matrix. He concluded that "great discoveries do not occur until the times are ready for them or, when they occur too early, are not great. In other words, the state of the times looks both before and after the discovery" (*ibid.*, p. 90). But the term *Zeitgeist* is not encountered until 15 years later. One first finds it in the book *Sensation and Perception in the History of Experimental Psychology* (6). Aside from one passing allusion to it in the context of Goethe's color theory, it is in the concluding chapter that Boring made use of it. Here he also broached one of the themes that pervades his various subsequent discussions of the concept: the inhibiting and facilitating effects or, in his later terminology, the "dual role" of the *Zeitgeist*. In this earliest treatment the negative side takes most of the chapter and the positive occupies only the last page as he ekes out virtues to match the defects, chiefly obstructive, for which he had held the *Zeitgeist* accountable.

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[2] There is one further detail that should be mentioned to complete this background. In 1921 the psychologist G. Stanley Hall, President of Clark University for many years, published an article (16a) entitled "The Message of the Zeitgeist." Though it is not concerned with the history of psychology but is, instead, a didactic plea for American universities to move up to a position of greater excellence and influence in shaping the future of the country, the term *Zeitgeist* occurs several times in that context. Boring served as professor of experimental psychology at Clark from 1919 to 1922 and, though Hall retired as President in 1919, it is not improbable that EGB saw or heard of this current essay by his eminent colleague. Did it perhaps serve as a harbinger and leave a memory trace for later reinforcement? Boring (7a) has himself drawn attention to such cryptic instances in the *modus operandi* of any given *Zeitgeist.*

But it was in 1950 that the construct came into its own. Though the *Zeitgeist* was not even mentioned in the first or 1929 edition of his *History of Experimental Psychology,* it serves practically as a leitmotif in the second or 1950 edition. A delectable example of the usefulness of the concept in that edition appears in the following juxtaposition. In the final chapter of the book Freud is ranked as one of psychology's four greatest men (the other three being Darwin, Helmholtz, and James), and that judgment is introduced by the comment: "Psychologists long refused him admission to their numbers, yet now he is seen as the greatest originator of all, the agent of the *Zeitgeist* who accomplished the invasion of psychology by the principle of the unconscious process." In the section devoted to psychoanalysis, 37 pages earlier, he had written: "It is not likely that the history of psychology can be written in the next three centuries without mention of Freud's name and still claim to be a general history of psychology. And there you have the best criterion of greatness: posthumous fame. The great man is he whom the historian cannot ignore. Perhaps, had Freud been smothered in his cradle, the times would have produced a substitute." Apart from the implication of ambivalence, there is here a striking example of Boring's acceptance of the *Zeitgeist* as the final arbiter. Not only does he interpret the great man as the agent or (to use Tolstoy's expression) the "slave" of history, but he makes the historian equally subservient to that same irresistible force!

While the book explicitly poses, for the first time in his writings, this question of the Great Man *versus* the *Zeitgeist* as the determiner of history, and though he affirms in his Preface that the two "are not mutually exclusive but the obverse and the reverse of every historical process," it is the *Zeitgeist* that, as in the passage quoted, has the edge. As time went on, he became more and more emphatic in this choice.

The title of the above-mentioned definitive statement in 1963 (11) was "Eponym as Placebo." In it Boring aligns himself with the *Zeitgeist* as against the Great Man. The eponym is a human convenience adapted to the limits of human attention and the need for looking up to heroes; but the true shaper of history, including the creation of eponyms, is the all-powerful *Zeitgeist*—the sum total of knowledge, belief, and sentiment that determines the behavior of scientists and of everyone else. Having accepted determinism as opposed to freedom, Boring endows the Great Man and the illusion of free will with an *epiphenomenal* existence. The events of history as the *phenomena* are truly determined by the *noumenon,* the *Zeitgeist.* Let it be observed that the words here chosen for the three grades of significance are not Boring's, but it is submitted that they fairly represent the essence of his argument as it reached its final stage in this valedictory.

From the very beginning of his serious concern with history Boring had been attempting to cope with the problem of synchronous discoveries—what Merton (19) later termed "multiples"—which appear to demonstrate the expendability of the discoverer or Great Man as a free agent, and, reciprocally, the inevitability of the discovery as a product of cultural forces (18, 19, 21). The problem of independent discoveries has been independently discovered many times over and long before the 20th century, as Merton has demonstrated in detail. But a question must be raised as to the presumed identity of these independent discoveries; another, regarding the dubious opposition of the Great Man and the *Zeitgeist.* Is not this dichotomy or disjunction a false one? If the *Zeitgeist* creates, or at least elects, the Great Man, is it not equally true that the Great Man helps to create or shape the *Zeitgeist?* Are we not dealing with a psychosocial or idiocultural parallelism? In any event, a challenge exists here. It is implied in Boring's own hints at further definition via the "psychodynamics of history," a theme that he broached in the last paragraph of his revised autobiography: ". . . I think that current psychology requires for its understanding a knowledge of its genesis in the minds of the men who went before, and that this genesis cannot be divorced from the personalities and attitudes of those who contributed to it. Current thought is best assessed if one knows the psychodynamics of its history" (10, p. 83).

One thus arrives at the crux of the present problem, a paradox which may be stated as a question: To what extent did the *Zeitgeist* select Boring to act as an agent for its own debut in the history of psychology; and, alternatively, did Boring by virtue of his personal psychodynamics create, or at least dignify, the concept by the constant application and reiteration of it?

An answer suggests itself if one reviews Boring's use of the *Zeitgeist* concept in the light of other events. In the broadest terms one observes that (*a*) he made no specific use of it in the first edition of his *History*—not until more than a decade later, by which time he had had the opportunity to digest the passing of his master and model Titchener; (*b*) that he had come head-on into collision with behaviorism, on the one hand, and psychoanalysis, on the other, as these gained acceptance during the 1930's and 1940's; and (*c*) that he had, after a period of extreme discomfort and inefficiency, entered into a personal psychoanalysis which in 1940 he described as having had little therapeutic effect, but which he later credited with having contributed to his eventual maturity (10, pp. 54-55, 247). One is struck by his own avowal that "about 1930, en route to Damascus, as it were, I had a great insight. I knew that I was unconscious and never had been conscious"—i.e., in the sense that introspection is supposed to capture consciousness instantaneously. Once a person has grasped the basic truth that introspection is inevitably retrospection—i.e., verbal report after the fact—and that "no system can include the report of itself . . . the introspectionist gladly and sincerely joins the behavioristic school," he concluded (8, p. 103). One must add his flirtation with another brand of the unconscious—the psychoanalytic—since in 1934-1935 he had a brief personal analysis, a more or less concurrent series of encounters with clinical psychology at Harvard, and later, a literary confrontation with it in preparing the section of his *History* in its second edition which, for the first time, included this topic. It is doubtful that his palingenesis came in a flash but there is no room for doubt that he had such a personality redintegration. His behavior from at least 1940 onward provides ample evidence for it. Moreover, he had not only been altered *by* the *Zeitgeist,* as he alleges in the above quotations: the chronological record indicates that his promulgation of the *Zeitgeist* itself was perhaps the most striking evidence of his conversion. What had happened?

There is, first, the overwhelming importance of Titchener to Boring's own history. Entering Cornell as an "uncultured engineer" (his own phrase), he found there a man who irresistibly complemented his matriarchal home and provided a paternal ego ideal which, after a short detour, took him from engineering into psychology. Titchener's staunch British ancestry and his devotion to the King's English furnished Boring with a model for his later distinctive writing style. But the chief *content* was also provided by Titchener who insisted upon the importance of history to the understanding of any topic in psychology. It was therefore natural for Boring to dedicate his masterpiece, the *History* published in 1929, to Titchener, who had died two years earlier. In a very real sense the book was a memorial to his master. But just previously, in 1927, he had hastened to write and to publish a careful and over-objective necrology of Titchener. In a prefatory note to its revision, which reads like an echo from his personal analysis, he acknowledged the immature "ambivalence" that had actuated him at the time (10, pp. 246-247). Then, on the tenth anniversary of Titchener's death Boring went through his letters from the deceased and published one long and one short paper based on them. Writing to Yerkes in 1945 he described his surprise at finding so little of permanent value in these letters. He commented: ". . . the assured Titchener did not invite correspondence about ideas with a satellite like me. The moon may noticeably affect the earth's tides but not its majestic course about the sun" (10, pp. 110-111). It is evident from these words, as well as from numerous other passages in Boring's writings, that his relationship to the master was highly ambivalent. He deeply resented the fact that the first lucky-unlucky 13 years of his professional career had been utterly dominated by a man who demanded complete allegiance, if not obedience, but who was destined to represent a brief and transitory part of psychology's *Zeitgeist*. So hero worship succumbed to a struggle with its antithesis. He rejected Titchener as formalistic, paternalistic, autocratic, and inflexible, while at the same time he admired him as being dignified, kind and considerate, loyal, and incorruptible. Finally, at the 40th anniversary of Titchener's death, in 1967 (the year before Boring himself died), he published one of his finest papers, "Titchener's Experimentalists" (12), in which he obviously strove to make amends for his earlier injustices. He states there that the picture of Titchener which has come down to us is unfairly one-sided, probably because Titchener spoke and wrote so freely about colleagues and causes to the son-disciples that he so implicitly trusted, and he personally takes the blame for most of the distortion. "Indeed there needs to be a good biography of him," Boring affirms. But the fact remains that, beginning around 1937, after his personal analysis with Sachs (whom, by the way, he described as markedly resembling Titchener and hence as very attractive to him at the start), he sought almost desperately to escape from the domination of his hero. To a very considerable extent the doctrine of the *Zeitgeist,* which Boring never tired of contrasting with the doctrine of the Great Man in the making of history, may thus be traced on its negative side to this ambivalent relationship and his valiant struggle to resolve it. As he stated in the above-mentioned letters to Yerkes: "It [the depressive experience with Titchener's insubstantial letters] showed of what stuff hero worship is made."

To this negative vector that drove him from his hero worship of Titchener may be added a positive vector that was acting on him in the 1930's and 1940's and became partially articulate in the terminal essay of his 1942 book

Sensation and Perception in the History of Psychology. As will be recalled, he outlined in the last chapter the factors that inhibit and those that facilitate scientific progress, and in that context he incidentally twice mentioned the *Zeitgeist*. The chapter was presumably written in 1941, about five years after his analysis and the year after the publication of his article "Was this Analysis a Success?" (5). During the 1940's the incidental *Zeitgeist* emerged as the definitive and pervasive construct found in the second edition of the *History*. This development may be attributed to Boring's need for conforming to the prevailing winds of doctrine, by then largely clinical and social, as well as experimental and behavioristic. The expanded content of the second edition, which actually no longer fitted the retained title, supports the inference that the author was attempting to conform to the needs of the time, as well as to the pressures of his publisher. The *Zeitgeist* concept thus viewed was a response not only to the negative vector away from Titchener but also to the positive one from his contemporary entourage.

In the foregoing terms Boring's insistence on the dual role of the *Zeitgeist* (8) is illuminated. The *Zeitgeist* inhibits discovery by fostering conformity and allegiance to the past and present; it facilitates discovery by asserting previous knowledge as a stabilizing counterpoise to wayward novelty. Ergo, the *Zeitgeist* is ambivalent (if, for a change, we use that adjective in the manner that Bleuler first recommended: i.e., as a characteristic not of the subject but of the object). But it is always easier to appreciate what Boring says about the inhibitory effects of the *Zeitgeist* than what he says about its facilitative functions. The negative features are patent but the positive ones seem to lie either in their challenging character—one gets something new by defying the *Zeitgeist*—or they are obvious to the point of platitude—the *Zeitgeist*, representing all previous knowledge, provides the prior condition for further progress. The "dual role" of the *Zeitgeist* seems to lack compelling justification, and one thus begins to suspect that the duality may inhere more in the subject than in the object. Was it Boring's own "ambivalence" regarding his past and present orientations as these tended to misshape his future that led him so magnetically to persist in this grand obsession? Is it not plausible that the negative vector of his reaction to Titchener (and the introspection of consciousness) and the positive vector toward the contemporary stress on the determinism of behavior (including the unconscious) joined forces to create the kind of concept that was, indeed, Boring's own *Zeitgeist?* Both the picturesque seductiveness and the discomforting vagueness of the creation may stem from this provenance.

A further vital question concerns the cogency of the *Zeitgeist* construct in any form. Boring averred that the *Zeitgeist* was aligned with the hard sciences—that it was *physicalist*—but it is not clear from the context (8, p. 103) whether he meant the contemporary *Zeitgeist* or the construct as such. He eschewed the dualist provenance of the *Zeitgeist* and disclaimed any "nonsense" that the spiritual part of the word suggested. But he did not define it operationally, not even by adequately describing its operational components. It is hence not surprising that the construct has been suspect and has been subjected to severe criticism, even repudiation (23), just as was Matthew Arnold's earlier usage with its less scientific pretensions.

There is considerable justification for these doubts. If the construct is to serve the historian of science, it must be clearly and operationally specified, perhaps even given up in favor of its residual components. For the historian at work must deal with measurable or, at least, ponderable entities, and the *Zeitgeist* under scrutiny in a particular instance resolves itself into such things as the prestige of a person or group with vested interests and desirable rewards to offer; a special place, like a given university, that commands respect; an active censorship or propaganda exercised by one or more individuals promoting their own interests or the interests of those who employ them as agents, etc. In other words, the *Zeitgeist* is not a passive, mysterious force, acting like the power of gravity in pre-Newtonian days. Once examined in truly physicalist or equivalent empirical terms, it appears as a very mundane congeries of forces that are open to description and assessment. The term *Zeitgeist,* as such, can lull the thinker by seduction to rest when what is needed is a vigorous reduction to operative empirical conditions. Or it may serve him to fortify the powers that be, possibly with the hope of joining them.[3] Determinism in physicalist terms is acceptable doctrine only if one can specify the effective parameters of the acting forces. Thus, only when gravity was analyzed into its components did it become physicalist, and only thus is it possible to operate successfully in altered conditions of "G" as did the romantically unromantic *Apollo* astronauts. But to define the *Zeitgeist* as "the sum total of knowledge and belief acting on an individual or group at any given time" is to use not physicalist but vague equivocal terms that do not allow for scientific analysis. And in all this reinterpretation one must recognize that physicalism, like physics today, is not the materialism of the 19th century but a set of empirical operations. It is to EGB's credit that in his latest comments on the *Zeitgeist,* he tended to equate it with social psychodynamics; but it will not be to his credit to have saddled our *Zeitgeist* with an "idol of the den" that graduate students of psychology take as the last word—as a solution—when, in fact, it but suggests a host of scientific problems awaiting investigation.

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[3] After this paper went to press the writer recollected the following apt but satiric passage in Goethe's *Faust* (Part I, lines 574*f.*): "My friend, . . . what you call the *Zeitgeist* is nothing but the spirit of that gentry in whom the times are mirrored. They are often a pitiful lot. One flees from them at the first glance. A rubbish can, a lumber room or, at most, a propaganda play have been ransacked for catchy aphorisms to put into the mouths of the puppets." (Author's translation.)

In this connection I reluctantly recall a personal encounter with the *Zeitgeist* as represented by Boring himself. It occurred very early in my professional life, the time of my first published paper (22). I had introduced the term *experimentee* as inclusive of both *subject* and *observer* (a term still used in those days) but found myself thwarted by a protracted campaign of opposition from him, by letter, interview, and memorandum, that eventuated in my diplomatic acceptance of the Department Chairman's judgment. As is now evident, the *Zeitgeist* was then standing in the way of a general insight that a generation later independently inspired a spate of investigations into the experimental situation as a psychological problem. For though Boring's opposition was directed at the novel term *experimentee,* that term was being employed by me in the context of a research program that highlighted the social psychology of behavior research. It was this total context with which my paper was concerned, but the context was lost on him and, as representative of the predominant *Zeitgeist,* he prevailed.

We may conclude that, as Boring left it, the *Zeitgeist* is an inchoate concept; it is not, except by hope, a physicalist or an operational one. For Boring it appears to have been a needed foil to a hero worship against which he had to rebel, as well as a means for "keeping up with the times." The "psychodynamics of history" or the "psychosocial matrix" with which he casually identified the *Zeitgeist* concept in his last years (11, p. 10f.) was never empirically developed by him; but it is through this implication that the torch passes on to those who are prepared to accept it. To act on that glimmering message is the most constructive honor that we can bestow upon him.

Everyone is inevitably involved in history since each of us has—each of us is—a history. In its broader meaning history shapes us all; a few are destined to shape it. Some elect to write history but few write it with the sense of organic continuity that makes the past live in the present and makes the present a prologue to the endless drama of living.To these happy few it is given to shape history by writing it—by writing it in a manner that is itself historic—and Boring was one of this select number. As concerns the history of psychology, it is no exaggeration to say that he stands alone in our time. His unique achievement, notwithstanding its omissions and its occasional lapses, has no other example of its class. Hence his example will for a long time to come inspire in others the hope of joining him by contributing to the kind of participant history-writing that he showed to be possible even for the grayest shades of that multispectrum over which the sciences of human nature range. Such was the quality of the historian Edwin Garrigues Boring: Eruditione Gesta Beavit—by his Erudition the Grist of history was Beatified.

Yet in the final evaluation even this and his other achievements pale in comparison with the kind of person that he was: a man of self-effacing humility ever confronting, with open laughter and hidden tears, the sort of man he wanted to become. His life, whatever its foibles, was an exemplification of the superego in its typical modes and its noblest aims: a tortuous self-appraisal reaching for a self-surpassing productiveness through every available mite of the "conflict-free sphere of the ego." He was, in truth, a "psychologist-at-large" because he was a psychologist who struggled for an existence with magnanimity.

Havelock Ellis in the Preface to his autobiography has captured the essence of such a man's baffling quandary: "The stuff of our lives is, indeed, a tangled web, yet in the end there is order. It may be long before order becomes clear, for life, when we reach below the surface, is full of complexity and full of contradictions. Thus it has taken me long to find out whether I am of weak or of strong character; I have seemed to those who knew me both the one and the other, and could myself find reasons on either side. But one might ask the same unprofitable question of the water or the wind. I see now that weakness and strength are only names for two necessary aspects of any possible approach, however humble, toward perfection" (14, p. xi).

Boring's identity was his bedevilment—a source of constant concern and pain born of "a war in the members." In counterpart the *Zeitgeist* became his escape from the obsessed ego. By this construction one finds it easier to understand why he chose that his ashes be scattered and that there should be no grave site and no stone. To put the matter in his own terms, he seems to have acted on the belief that, having emerged from and contributed to the anonymous *Zeitgeist,* one should return into it. One's accumulated debts to Nature could thus also be repaid, with "Zeitgeist" as placebo. All else is vanity, as it is written in Ecclesiastes, where it is also written that there is nothing new under the sun. We must grant Boring and Koheleth the large measure of truth that inheres in this view. But "the sun also rises" and we may therefore retain some measure of reservation, the more to honor what remains of E. G. Boring in memory and for example.

As we meet and as we miss him,
As we mourn his vacant chair,
We still struggle to possess him—
In his eponym to share.

Summary

An appreciation of E. G. Boring, who died on July 1, 1968, is combined with a critical examination of his concept of the *Zeitgeist*. The history of the concept before Boring is surveyed. The evolution of it in his writings is traced in detail. In Boring's own life and work the construct satisfied certain personal needs, and this dependence limits its general usefulness. As Boring himself occasionally stated, the *Zeitgeist* is reducible to certain specific psychosocial influences that determine the current of scientific belief and opinion at a given time. These influences should be examined and specified as such in historical analysis. Reliance upon the *Zeitgeist* construct itself, which is so approximate, can be misleading.

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EFFECTS OF KNOWLEDGE OF RESULTS AND METHOD OF PAYOFF ON KEEPING-TRACK PERFORMANCE*

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A. INTRODUCTION

One model of keeping-track performance postulates that when *S*s are required to tally mentally the number of occurrences of each of four stimuli (categories) presented sequentially, they do not rehearse the names of the stimuli to be remembered. Instead they perform the task by picturing mentally a set of windows, one corresponding to each of the four different categories, keep individual running tallies in each window, and rehearse only the tallies after each presentation of a new stimulus in one of the categories (5, 6).

Little is known, however, about the specifics of the manner in which *S*s employ the "spatial window" technique or the extent to which motivational variables can be used to modify the keeping-track strategies normally employed. Research conducted by Yntema (8) with a subject-paced task, considerably different than the experimenter-paced task employed in the above studies, suggests that man's capacity to keep track of a random situation in which any of the information channels is capable of attaining any one of its possible states with equal probability is fairly low, and that *S*s may not be able to keep track perfectly of even two or three things at once.

The purpose of the present experiment was to employ knowledge of results (KR) and financial incentives containing "motivational" but not "directive" properties (4) to manipulate *S*s' keeping-track strategies in order to determine more about the use of the "spatial window" technique; i.e., do *S*s tend to optimize performance with one or two windows as Yntema's (8) research would suggest, or can they maintain optimal performance with all four?

B. EXPERIMENT I

1. *Subjects*

The *S*s were 64 U.S. Army enlisted men with a minimum General-Technical subtest score of 100 on the AGCT.

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2. *Apparatus*

The stimulus presentation apparatus has been described more fully elsewhere (6). Briefly, *S* was seated in front of a panel, the face of which was positioned approximately two feet from his eyes at a 60° angle below his horizontal line of sight. A rear projection display unit (Industrial Electronics Engineers, Inc.) was mounted in the panel. The display unit contained lenses each etched with one of the stimuli to be presented to *S*. By turning on and off individual lights behind each of the lenses, the stimuli, seen as an outline of light against a dark background, were projected one at a time onto approximately the same location of a 1½ by 1⅞ inches frosted glass surface. All sequences of stimuli and stimulus durations were preprogrammed and controlled by Massey-Dickinson Co. programming modules located in an adjoining room.

In addition to the stimulus projector, two small lights, one labeled QR and one labeled ST, were placed just below the display unit. A coin box used to dispense nickels to the *S*s was located just to the right of the display panel. Both the lights and the coin dispenser were removed from the room during testing of the *S*s for which they were not required.

3. *Procedure*

Stimuli were projected one at a time onto the surface of the rear projection display unit. The *S*s task was to observe and tally mentally the number of occurrences of each of four different stimuli (the letters Q, R, S, and T) presented sequentially and to record the tally in writing at the end of each sequence. Upon completion of the written answer, they were then instructed to read that answer aloud into an intercom. Letters were presented at the rate of one every second with an on-time of .5 second and an interstimulus off-time of .5 second. The beginning and end of each sequence was signaled by a 2500 Hz tone.

Trial length, defined as the total number of stimuli presented in a sequence, was included as a within-*S*s variable. All *S*s were presented with trial lengths of 8, 12, 16, and 20 stimuli. Each of the four trial lengths was presented twice in random order during each of four blocks of eight trials. The sequences of letters were chosen at random with the restriction that each letter appeared at least once on every trial.

Two practice trials were given to insure that *S*s understood the instructions. These trials were followed by the 32 experimental trials each separated by a 15-second interval for recording answers.

The *S*s were randomly divided into four groups of 16 each differing in terms of the KR and financial incentives provided. The Control group performed the task as in previous experiments without any form of incentive or feedback whatsoever. The KR group received KR by means of the small lights labeled QR and ST, immediately following the report of each tally. Thus, if *S* reported a correct tally of both Q and R, the QR light was illuminated. If *S* reported a correct tally of both S and T, the ST light was illuminated. If *S* reported a correct tally of all four letters then both lamps were illuminated. In addition to KR, provided in the same manner as above, the Split Incentive group received a five-cent reward for reporting the correct number of Q's and R's or a five-cent reward for reporting the correct number of S's and T's presented. Thus, a 10-cent reward was dispensed for perfect performance. Finally, the Total Incentive group received KR in the same manner as the two previous groups, but a 15-cent reward only if all four letters were tallied correctly.

4. *Results*

The sum of the absolute differences between the number of each letter presented in a pair and the number reported was used as the measure of performance. Thus, if 5 Q's, 3 R's, 2 S's, and 2 T's were presented on a given trial and *S* reported 6 Q's, 2 R's, 2 S's, and 2 T's, then the error for that trial would be 2 for the QR pair and zero for the ST pair. The absolute error scores per pair for the two equal trial lengths within each block were summed and subjected to an analysis of variance (1) with Groups as a between effect and Trial Length, Blocks and Pairs (QR *vs.* ST) as within effects.

The data underlying the significant main effects indicated that, in general, the longer the Trial Length the poorer the performance, $F\ (3{,}180) = 150.25$ ($p < .001$), performance improved with practice or Blocks, $F\ (3{,}180) = 7.36$ ($p < .001$), performance varied as a function of Pairs, $F\ (1{,}60) = 10.58$ ($p < .001$) with mean errors respectively of 1.65 for the QR pair and 1.97 for the ST pair, and as a function of Groups, $F\ (3{,}60 = 2.98$ ($p < .05$). With respect to this latter effect the Control group made an average of 3.45 errors per trial, the KR group, an average of 3.41 errors, the Split Incentive group, an average of 3.30 errors and the Total Incentive group, an average of 4.34 errors per trial.

Only three of the interactions reached statistical significance. The Trial Length × Blocks interaction, $F\ (9{,}540) = 5.73$ ($p < .001$), indicated that, in general, the longer the trial length the greater the improvement with practice, while the Trial Length × Blocks × Pairs interaction, $F\ (9{,}540) = 3.10$ ($p < .001$) indicated that the effect in turn was a function of Pairs with greater improvement resulting on the QR pair than on the ST pair. Finally, examination of the data underlying the Trial Length × Group interaction, F (9,180) = 2.23 ($p < .05$), indicated that while all groups showed a monotonic increase in errors with an increase in trial length the rate of increase was greater for the Total Incentive group than for the remaining three groups.

C. EXPERIMENT II

1. *Subjects*

The *S*s were 16 U.S. Army enlisted men with a minimum General-Technical subtest score of 100 on the AGCT.

2. *Apparatus and Procedure*

The apparatus and general procedures were identical to those of Experiment I except that *S*s were assigned to two groups of eight each. As in the KR group of the previous experiment both groups received KR independently for the QR pair and the ST pair. One group, however (the 5-10 group), received a five-cent reward, if they reported the correct tally of the QR pair, and a 10-cent reward, if they reported the correct tally of the ST pair. Thus, if they reported the correct tally of all four letters, they received a 15-cent reward. The second group (the 10-5 group) was treated identically except they received the 10-cent reward for the QR pair and the five-cent reward for the ST pair.

3. *Results*

The data were scored in the same manner as in the first experiment and subjected to an analysis of variance (1) with Groups as a between effect and Trial Length, Blocks and Value (five cents *versus* 10 cents) as within effects. Only the main effects for Trial Length F (3,42) = 36.51 ($p < .001$) and Blocks F (3,42) = 3.21 ($p < .05$) were significant. The data underlying each of these effects indicated that, as in the first experiment, performance varied inversely with Trial Length and directly with the amount of practice or Blocks. Although all other effects failed to reach significance, the findings for Value, F (1,14) = 3.67 ($p < .10$), indicated a trend with a 10-cent reward leading to less errors than a reward of five cents. The lack of a Groups effect ($F < 1$), as well as the lack of a Groups × Value interaction ($F < 1$), further suggested that the trends with Value were consistent with both QR and ST pairs. Finally as suggested in this analysis and confirmed in a separate analysis, over-all performance did not vary as a function of Pairs

TABLE 1
MEAN ERRORS PER PAIR AND MEAN ERRORS PER TRIAL AS A FUNCTION OF GROUPS FOR EXPERIMENTS I AND II

Groups	Pair QR	 ST	Mean errors per trial
Control	1.67	1.78	3.45
KR	1.45	1.96	3.41
Split incentive (5-5)	1.52	1.78	3.30
Total incentive (15)	1.97	2.37	4.34
5-10	1.84	1.55	3.39
10-5	1.36	1.83	3.19

($F < 1$). These latter findings may be seen in Table 1, which presents the mean errors per trial and mean errors per pair for both experiments.

D. DISCUSSION

In general, keeping-track performance in the present experiments resembled that of earlier experiments; that is, orderly relationships as a function of Blocks and Trial Length were noted. It can be seen from Table 1 that the differences between Groups noted in Experiment I can be accounted for primarily by virtue of the fact that the Total Incentive group made considerably more errors than the other three groups. The longer the trial length the greater this difference. Neither KR nor financial incentives, then, were effective in bringing about improvement in performance.

These results are totally consistent with the observation made by Locke and Bryan (4). They demonstrated that if KR has motivational properties only and does not inform *S* of the nature of his errors or suggest how those errors might be corrected (such as the KR employed in the present study), then changes in performance will result only when KR affects the goal setting of the *S*. No differences in performance were noted between the Control group, the KR group, and the Split Incentive group presumably because the incentive did not modify *S*'s goal of maximizing performance with two categories (as indicated by the superiority of performance with the QR pair over the ST pair). By contrast the total incentive condition forced *S* to modify this goal or strategy and try for perfect performance in all four categories with the resultant disruption of performance. This latter effect would seem to support Yntema's (8) contention that *S*s may not be able to keep track perfectly of even two or three things at once.

In Experiment II, the failure of Value to reach statistical significance would seem to indicate that in contrast to the observations of Christ (2), Kanarick and Petersen (3), and Taub (7), differential value failed to produce selectivity in performance. However, considering the small number of *S*s, the finding of a trend with Value in combination with a lack of effect for Pairs suggests that financial incentive did appear to induce changes in the *S*'s goal or strategy. That is, in contrast to Experiment I where *S*s consistently performed better with the QR pair, *S*s in Experiment II exhibited no letter preferences. Thus, the trend towards less errors with a 10-cent reward was present regardless of the letter pair that was rewarded. This is interpreted to mean that differential value does produce selectivity in keeping-track performance, since it did change *S*s' goals and modify that strategy normally adopted by the *S*s (i.e., the tendency to optimize performance with the QR pair). Examination of the data in Table 1 clearly supports this interpretation.

In summary, then, the present experiments suggest, in terms of the model previously proposed, that *S*s' capacity to keep track is limited to two or three categories and that they will normally adopt a strategy which will optimize performance with the QR pair possibly because Q and R represent the "spatial windows" on the extreme left or because they are rehearsed first. Providing KR or financial incentives having motivational but not directive properties in a manner consistent with this strategy fails to affect the absolute level of performance indicating that *S*s perform at capacity without such incentives. On the other hand, if offered an incentive which calls for a strategy that will result in perfect performance in all four categories, performance deteriorates again attesting to the limits of *S*'s keeping-track performance. Finally, assignment of differential values to the categories resulted in selectivity of performance so that those categories bearing the highest value tend to lead to the best performance. However, as performance with the high valued categories is enhanced, performance with the remaining categories deteriorates.

E. Summary

Knowledge of results and financial incentives having "motivational" as opposed to "directive" properties (4) were utilized to further examine the "spatial window" model of keeping-track performance. It was found that when *S*s are required to keep track of four categories of information at once they will normally optimize performance with two of these categories. If incentives are provided which call for optimal performance with all four categories, overall performance deteriorates. Implications for the spatial window model were discussed.

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ALTERATION OF MOOD VIA MUSIC: A STUDY OF THE VECTORING EFFECT*

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A. INTRODUCTION

The "Iso" principle of music therapy has been employed in psychiatry to alter disruptive affective states of mental patients (1, 2, 3). Music is selected to match the actual mood of the subject person, the negative affect that we would alter. For example, if the mood of the subject were depressive, then blue and depressive music might be matched to the depressive mood of the subject. This is the "Iso or "similar" phase of music stimulation. Then by stages the content and quality of the music is changed towards a happy cheerful feeling-tone, thereby altering the mood of the subject into a happy cheerful direction. This is the step-wise "vectoring" or directed movement of music to the desired goal: e.g., from sad to cheerful, or restless to tranquil, or bored to stimulated.

The rationale for the "Iso" principle states that matching the mood of the music to the mood of the subject we grasp his attention and hold it sufficiently to enable us then to alter his mood by step-wise changes in the music. If we do not match the music to his mood, the patient will reject the attempt to approach him via music. For example, a restless mood will not respond to tranquil music; rather we must match restless music to the restless mood. Then by degrees we can shift the music thereby carrying with it the subject's mood to a more tranquil state.

There is abundant evidence that specific pieces or varieties of music evoke definite types of mood reactions (6, 7, 8, 9). Not all listeners have the very same mood reactions to the same pieces but there is certainly a common or modal type of mood response which is predictable for various pieces of music.

The "vectoring" power of music: i.e., the directed alteration of mood through music—an alteration from one affective pole to its opposite or its contrast—has not yet been explored. We present the results of such an investigation into the stage-wise vectoring effect of music upon a group of normal young men.

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Hypothesis: That the mood response of normal subjects to music can be altered or vectored along an affective continuum between two contrasting antipodes of emotion (mood). Beginning at one polar mood or musical experience we can, through properly selected music, move (or vector) the affective state "up" (or "down") by step-wise stages into its antipolar or contrasted mood reaction.

B. Method

1. *Subjects*

Seventy-four male college upperclassmen in a small urban private liberal arts college participated in this experiment. Mean age was 20.4 years; most were in their Junior year of college.

2. *Procedure*

All students ($N = 74$) sat in a lecture-hall where the music was broadcast from a record player of good fidelity. A rating form was distributed (see Appendix A). The following instructions were read to the group

> People have various reactions to music. We wish to study this. We will play some musical excerpts. After this is done, you will check on the Rating Form the way you felt emotionally from the beginning to the end of the excerpts. If there was no special effect on you, check "None of These."

The first set of excerpts was then played and the students checked their responses. The second set followed, and so on until all four sets had been played and the Rating Form had been checked four times, once for each set of excerpts.

3. *Music Materials*

A published series of recordings, developed on the basis of clinical and aesthetic judgement in accordance with the "Iso" principle of music therapy, was used as the music stimulus material (10). The content consisted of excerpts from classical music, primarily instrumental but with one choral piece. These excerpts were drawn together by a sensitive and very knowledgeable musician[1] in consultation with an experienced clinical psychologist.

Four different affective continua were represented: (*a*) Sad and depressed *to* gay and happy. (*b*) Restless and agitated *to* serene and tranquil. (*c*) Bored and listless *to* active and alert. (*d*) Active and alert *to* majestic and exalted.

Although the original published excerpts for the four continua lasted from about 22 to 44 minutes per continuum, we compressed these into only eight minutes each by taking four two-minute samplings from the beginning to the end of each continuum respectively. In this sense we demanded more from the music by drastically shortening its exposure time and thereby sharpening the test of its power to evoke subjective mood changes.

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[1] Horace Grenell, to whom thanks are extended for his encouragement and assistance.

C. Results

Table 1 shows the distribution of responses for each of the four music series. For example, in response to the "Sad *to* Gay" musical excerpts 36 subjects reported a "Sad *to* Gay" emotional feeling in themselves, four reported a "Restless *to* Tranquil" response, 24 reported a "Bored *to* Active" response and six reported "None of These." Chi square tests were conducted for each of the four continua and in every instance they demonstrated a significant association between the stimulus music continuum and the cognate mood response of the subjects ($p = .001$ in each and every case). The mood vectoring of the music selections did cause the subjective mood response of normal college men ($N = 76$) to vary *pari-passu* with the mood changes which that music purposefully sought to induce.

TABLE 1
Correspondence Between Vectored Stimulus Music Selections and Reported Mood Changes ($N = 76$)

	Vectored Stimulus Music Selections			
Reported Mood Changes	Sad *to* Gay	Restless *to* Serene	Bored *to* Active	Active *to* Majestic
Sad *to* Gay	36	1	17	7
Restless *to* Serene	4	66	0	1
Bored *to* Active	24	1	46	4
Active *to* Majestic	6	4	3	49
None of the Above	6	4	10	15

D. Discussion

These results, within the limits of the experiment, demonstrate that musical excerpts can be selected and joined together to create a definite vectoring effect upon the mood of the normal listener. The four affective dimensions which we studied were: Sad *to* Gay, Restless *to* Serene, Bored *to* Active, and Active *to* Majestic.

Heretofore the greater part of experimental studies of mood responses to music have sought to demonstrate, and they have done so successfully, that specific music selections tend to evoke specific emotions (4, 5, 9). We have now adduced firm evidence that mood *changes* can be vectored by music along specified affective dimensions. This is basic to the "Iso" principle of music therapy, for unless the existence of the vectoring effect can be validly demonstrated then the applied usefulness of the "Iso" matching principle (where music is matched to the current mood that we would change) remains in doubt.

The actual effectiveness of our vectored music stimuli did differ from dimension to dimension (see Table 1). The Restless *to* Serene continuum was the most clearly defined of all. It is reasonable to infer that certain of the dimensions were so close to each other, for example Sad *to* Gay and Bored *to* Active, that the mood delineation became fuzzy and therefore the subjects' reported mood reactions were not so statistically clear or mutually exclusive as we might optimally desire. This could be due to the choice of music excerpts, or to excessively close relationship between the affective dimensions, or to both. The music vector Active *to* Majestic yielded more "don't know" ("None of the Above") responses than did any of the other vectors. This dimension was perhaps weakly conceived.

Further investigations of the vectoring effect of music might draw upon psychological factorial analyses which have been made of underlying and more basic dimensions of mood or affect. These factor analytic dimensions should provide a foundation for the construction of vectored music stimuli specific to each of the several factorially demonstrated basic dimensions.

The familiarity of the subjects with the music stimuli, the aesthetic sophistication of the audience and similar varied qualities of the listeners will definitely influence their response to the music. But this has always been so with music. No matter what the psychological use to which we put music, careful evaluation of the nature of the listening audience is a primary requisite for the experimenter who would employ music to influence the affect or mood of his audience.

E. SUMMARY

There is ample evidence that music may evoke specific mood or affective reactions in the listener but minimal published evidence that mood may be selectively altered through the application of step-wise gradients via the music stimuli. The selective alteration of subjective mood responses via the stepwise "vectoring" effect of music was demonstrated with a group of normal young men ($N = 76$). This effect is basic to the "Iso" method which has been suggested as a technique to change the mood of disturbed mental patients.

Subjects ($N = 76$) rated their actual mood responses to each of four sets of recorded music stimuli. Each set consisted of a series of brief classical music excerpts which covered a specific mood dimension or continuum: (*a*) Depressed *to* Happy, (*b*) Agitated *to* Serene, (*c*) Bored *to* Active, and (*d*) Active *to* Majestic. Chi square analyses of the ratings indicated for each of the dimensions that the subjective step-wise mood response of the subjects was consistent with the intended vectoring effect of the music selections ($p = .001$). Similar investigations were suggested for mood dimensions which might be derived from factorial studies of personality.

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APPENDIX A

Name: ________________________ Age: _____ Last Grade Completed: _____

Familiarity With Classical Music: ( ) *Little or None* ( ) *Average* ( ) *Above Average or Play An Instrument*

Emotional Dimension (Your Inner Feeling)	*Music Selections*			
	1	*2*	*3*	*4*
(A) Restless, Agitated, Tense, Troubled — To — Serene, Tranquil, Soothing, Restful	( )	( )	( )	( )
(B) Sad, Depressed, Melancholy, Tragic — To — Gay, Happy, Bright, Joyous	( )	( )	( )	( )
(C) Active, Alert, Stimulated, Cheerful — To — Majestic, Exhalted, Stirring, Martial	( )	( )	( )	( )
(D) Bored, Listless, Passive, Lonely — To — Active, Alert, Stimulated, Cheerful	( )	( )	( )	( )
(E) None of These ________________________	( )	( )	( )	( )

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A METHOD AND MODEL FOR AUTOMATED ASSESSMENT OF HUMAN JUDGMENT*

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A. INTRODUCTION

In the planning of a proposed clinical evaluation of certain drugs, there was felt to be a need for obtaining an objective estimation of any drug-induced change that might occur in the quality of the mind's performance called judgment-making. The test, optimally, should (*a*) be easily administered, (*b*) not require, nor be influenced by, any special skill, previous experience, or knowledge on the part of the subject, (*c*) permit administration and scoring without interference by subjective bias on the part of the tester, (*d*) permit estimations of change in judgment without the subject being aware that judgment is the quality being appraised, (*e*) permit administration of the test without any special requirement of skill, training, or knowledge on the part of the tester, (*f*) permit serial appraisals of a subject's judgment at short intervals without significant interference from learning or practice effect, and (*g*) provide reasonably reproducible test scores under similar conditions on different occasions. This paper describes a method and a machine which together appear to provide a means for estimating at least one aspect of human judgment and which also appear to meet the above desired conditions.

B. HYPOTHESIS

As a beginning hypothesis it is taken that making a judgment is "the process by which you arrive at a decision when you don't have all the facts. First you take the facts you *do* have; then you make an educated guess as to what they probably add up to."[2] It is assumed that making a judgment is coming to a decision from which a person expects that there will result a greater tangible or intangible benefit to him than if no judgment and no decision were made at all. The decision may be to take some action or to take no action. From observation and retrospective analysis it appears that, when stimulated to make

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[1] The authors wish to thank Patricia J. Newman for valuable technical assistance.

[2] Froman, R. How bad is your judgement? *This Week Magazine,* 1966.

a judgment, a person arrives at a decision after having come to have a feeling with respect to the probability that a certain event will (or will not) occur in the future, based upon his weighing of past perceptions and experiences, real, symbolic, or imaginary, recallable or subconscious, firsthand or from hearsay. The process by which all factors are weighed and integrated prior to the making of a decision is regarded herein as judgment-making. The "quality" of judgment may be estimated by relating the quality of the decision to all prior relevant perceptions and experiences.

In the method to be described the subject is motivated to make a series of decisions, each of which is preceded by one of a succession of new bits of information. The quality of the judgment-making process leading to each decision is determined by comparing (*a*) the confidence with which the subject indicates that he feels each decision is going to be correct with (*b*) the number and relevance of all bits of information then known to have been revealed to him prior to each decision. In other words, the degree of confidence with which a subject expects a given decision to be correct appropriately should vary directly with and in proportion to the amount and kind of pertinent information then available to him for use in the judgment-making process. Any appreciable dislocation of this relationship is regarded as an indication of either inappropriate overconfidence or underconfidence, both of which are noted separately as different kinds of "poor judgment."

C. Method

A brief description of the rules for "playing the game" will facilitate understanding of the principles embodied in the method and of the operation of the machine. The subject is given 100 points of score and the pointer on the scoring mechanism (Figure 1-B) is set to 100. The object of the game is to increase score as much as possible in the time allotted (in the present study, 20 minutes). On left of the console (Figure 1-A) are three "bet" buttons bearing designations 1, 5, and 10, and on the right is an array of 49 "play" buttons arranged in seven rows of seven buttons each. A single play operation consists of first pressing one bet button followed by the pressing of one play button. When a correct play button is pressed, a chime sounds. The button at the intersection of the two lines (column 2 and line 6) is always the first correct play in each "game," and the next correct play and each succeeding correct play is always no more than one button removed, horizontally, vertically, or diagonally from the last previously indicated correct play button. After the first play each subsequent correct play button must be found by trial and error until such time subject may suspect he recognizes a simple geometric pattern or sequence in which the correct plays have occurred and are likely to recur. By noting and remembering which buttons have given indications of correct play and the order in which correct plays occurred subject will be able to repeat the same pattern of play one or more times within a given game.

The subject is shown several drawings of possible patterns, such as a clockwise circuit around the corners of a square, a counter-clockwise circuit around a triangle, a parallelogram, or a "progressive" sequence, such as a "saw-tooth" or a "step" pattern. For each new game there is a different pattern which must be found. Score increases or decreases by the amount bet. Subject is instructed that once he finds the correct pattern for a given game, he should continue making plays in the same sequence, since the pattern will not change throughout a given game.

If it is the subject's first test, a loop of punched tape on which is coded a preprogrammed series of practice games is threaded into the tape-reader component (Figure 1C). Subject is permitted to play until it is evident that he understands the mechanisms of betting and playing.

For actual test, the tape reader is threaded with a tape providing 26 different games, each with a different pattern. The subject is instructed to play as quickly as possible through all 26 games or for 20 minutes of playing time, whichever comes first. Existing score and the trend of its change may be noted by the subject from position of the recording pen and the ink trace on the paper.

Each bet and play that is made provides signals which are conveyed to a portion of the control component where they are channeled and modified in ways which are designed to provide readouts (not visible to subject) which reveal information regarding the quality of judgment the subject exhibited by the manner of his betting.

During the first part of each game when the subject has found only a small percentage of the correct play buttons for a given pattern, the total number of his relevant experiences (the number and positions of the correct plays) is not sufficient to permit any rational deduction with respect to the position of the next correct play button. Accordingly, during this phase of each game, a value of 1 is caused to be represented on an electromechanical stepper switch in the machine, and the subject's actual bet before each play (1, 5, or 10) is matched for identity or disparity with the value of 1, and any disparity is accumulated on a (+) digital counter (not visible to subject) as "units of bad judgment due to overconfidence."

At some point in each game, when a play is revealed to have been correct,

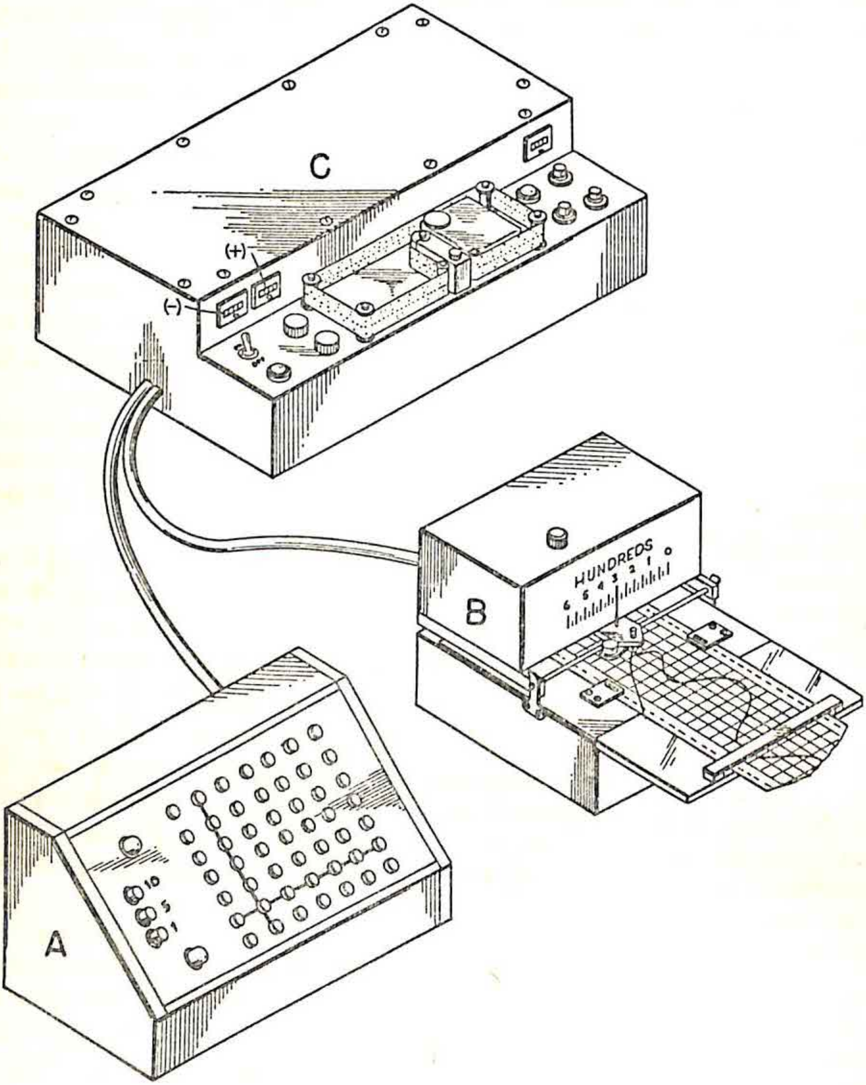

FIGURE 1
DRAWING OF COMPONENTS

A—Console showing BET and PLAY buttons. B—Strip-chart recorder for displaying and recording SCORE. C—Control component with tape reader, tape loop, (+) and (—) counters.

this bit of new information plus the previously revealed positions of prior correct plays can now permit, to some degree, a rational deduction to be made with respect to the configuration of the correct pattern. At this point when the subject's potentially useable past experiences are sufficient for making a deduction with a 50-percent or better probability as to the position of the next correct play button, the stepper switch is caused to advance one step so that instead of a value of 1, a value of 5 is represented on the stepper switch and the subject's bet for the next following play will be matched for identity or disparity with the value of 5. And, if the subject's next play is correct (thereby providing substantial confirmation that the pattern has been correctly identified) the stepper is caused to advance one more position so as to represent a value of 10, and thereafter, for the remainder of the particular game, each of the subject's bets will be matched against the value of 10 so long as each of the subject's plays is correct. If the subject bets less than the value of 5 or 10 as represented on the stepper switch and his plays are correct, the disparity will be recorded on a different (—) digital counter (also not visible to subject) as "units of bad judgment due to underconfidence."

The value of 1 on the stepper switch is assigned to have a numerical equivalence representing all amounts of relevant information available to the subject which are insufficient to permit a deduction with 50-percent or greater probability with respect to the position of the next correct play. Similarly, the highest value of 10 on the stepper switch is assigned to have a numerical representation of the amount of information that is just sufficient and all amounts that are more than sufficient for deducing with 100-percent probability the position of the next correct play button. However, the value of 5 has an intermediate equivalence, usually representing that amount of information that is sufficient to permit a deduction that one of only two possible alternate choices of play may be correct.

It may be seen that the subject's bet before each play is matched against an internally programmed numerical value that represents the total informational basis upon which the subject could logically conclude that his next play has less than an even chance, an approximately even chance, or a substantially better than even chance of being correct. If the amount of relevant information which has been made available to the subject is the sole basis upon which a subject can objectively and rationally select the size of his bet, then it follows that any bet which is greater than or less than the internally programmed value provides indication of poor judgment due to overconfidence or underconfidence respectively. And, if a subject were to bet successively throughout a game, amounts that corresponded exactly to the values that were programmed to represent the successive "appropriate" bets, there would be no instance of mismatch and therefore no readout of indications of either over- or underconfidence, and within the context of the present method, the subject would thereby have exhibited the best of "good" judgment in playing that game.

An adjustment means is also provided in the machine for conditions in which subjects may not be able to find the correct pattern, or may forget the position of their last correct play. In such situations, if the subject appropriately feels lack of confidence that his next play will be correct and bets only 1 and his next play is incorrect, there will be no readout of underconfidence on the (—) counter and he will thereby, in effect, be credited with good judgment. Furthermore, the event of his making the incorrect play provides an electrical signal which retards the stepper switch to the next lower value (if it had been at 5 or 10) and this is repeated if his next following play is also incorrect. Thereafter, the stepper switch is caused to advance one position higher following each correct play as an adjustment for the probability that the subject has found his place, and thence to the highest value of 10 if his next following play is also correct, but any intervening incorrect play will cause the stepper switch to be retarded to the next lower value. In such manner, the "appropriate bet value" is automatically adjusted, step by step, to a wide variety of playing performances while retaining sensitivity to those actions that are most particularly revealing of judgment.

Also taken into account is the magnitude of the subject's score (his existing assets) which appropriately should influence the subject's selection of the amount of his bet. A subject who has attained a substantially higher score after playing several games will have shown his ability to gain score points. Having accumulated appreciable assets, he may feel justifiable confidence in risking more points by betting higher sooner. As the subject's score increases, an adjustment is automatically made for diminishing the readout of overconfidence (+) units if he bets higher and sooner than when his score was lower. Similarly, a subject who has gained little or no additional score or has lost some of his starting score should have recognized that his ability to gain additional score points has been poor. In this situation he should be aware that his manner of betting and playing has not profited him and that it would be appropriate for him to conserve his remaining assets. Accordingly, means are provided to increase substantially the readout of overconfidence (+) units when the subject has a low score and "inappropriately" bets high, and to decrease the readout of underconfidence (—) units if he bets low. The adjustment means for changing the readout of over- and underconfidence units on

TABLE 1

NUMBER OF UNITS OF OVER- AND UNDERCONFIDENCE CHARGED AGAINST SUBJECT WHEN HIS BET IS INAPPROPRIATELY HIGHER OR LOWER THAN THAT PROGRAMMED AND WHEN HIS ACCOMPANYING PLAY IS EITHER CORRECT OR INCORRECT

If the appropriate bet is:	And the subject's actual bet is:	And the subject's existing score is:						
		< 50[a]	50-140[a]	140-230[a]	230-320[a]	320-410[a]	> 410[a]	any score[b]
		Units of overconfidence (+) or underconfidence (—)[a]						
1	10	+8	+6	+5	+4	+3	+2	+8
	5	+4	+3	+2	+2	+1	+1	+4
	1	0	0	0	0	0	0	0
5	10	+4	+3	+2	+2	+1	+1	+8
	5	0	0	0	0	0	0	+4
	1	—1	—2	—3	—3	—4	—4	0
10	10	0	0	0	0	0	0	+8
	5	—1	—2	—3	—3	—4	—4	+4
	1	—2	—4	—5	—6	—7	—8	0

[a] Units will be recorded on counters if play is correct.
[b] Units will be recorded on counters if play is incorrect.

the (+) and (—) counters are linked to the score-recording mechanisms and the adjustments are made in step fashion so as to cover six different score ranges.

Table 1 presents the sliding scale of (+) and (—) units assigned to the differences between the appropriate bets and the subject's bets for each of the six different score ranges when the subject's subsequent play is correct. Also, as shown in Table 1, if a subject should bet more than 1 regardless of his existing score, and his subsequent play is incorrect, such an error in judgment (including carelessness) is deserving of the maximum "penalty" of 4 units or 8 units of inappropriate overconfidence if his actual bets were 5 or 10 respectively. In such manner are provisions made for recording (*a*) different numbers of units of over- or underconfidence following a given play depending upon the subject's existing score and (*b*) the maximum penalty for inappropriate confidence whenever a play is incorrect and the accompanying bet is greater than 1.

The number of overconfidence (+) and underconfidence (—) units accumulated on the two counters provide an indication of the general quality of judgment exhibited by the subject while performing the test, and also, more particularly, the directional quality of the judgment with respect to his having exhibited a preponderance of overconfidence or of underconfidence.

1. *Apparatus*

It is beyond the scope of this paper to present a detailed description of the electromechanical components and circuitry of the machine. The design of the present model is only one of several alternates which could serve the same functions as have been described. In Figure 2 is shown a block diagram of the components and the control pathways for translating the subject's bets and plays into changes of score and units of inappropriate betting on the (+) and (—) counters.

On the first three channels of the punched tape is encoded the line, and on the next three channels the column in which each correct play button is located such that only when the correct play button is pressed is electrical continuity made at the intersection of column and line and the correctness of the play is sensed by activation of a "right or wrong" relay. Pressing of buttons at all other intersections fails to activate the relay, thereby permitting electrical continuity through the normally made contacts, and an incorrect play is indicated.

A hole placed in channel 7 on the tape (in line with the last play for which the appropriate bet is 1) closes a relay and makes operative the bidirectional

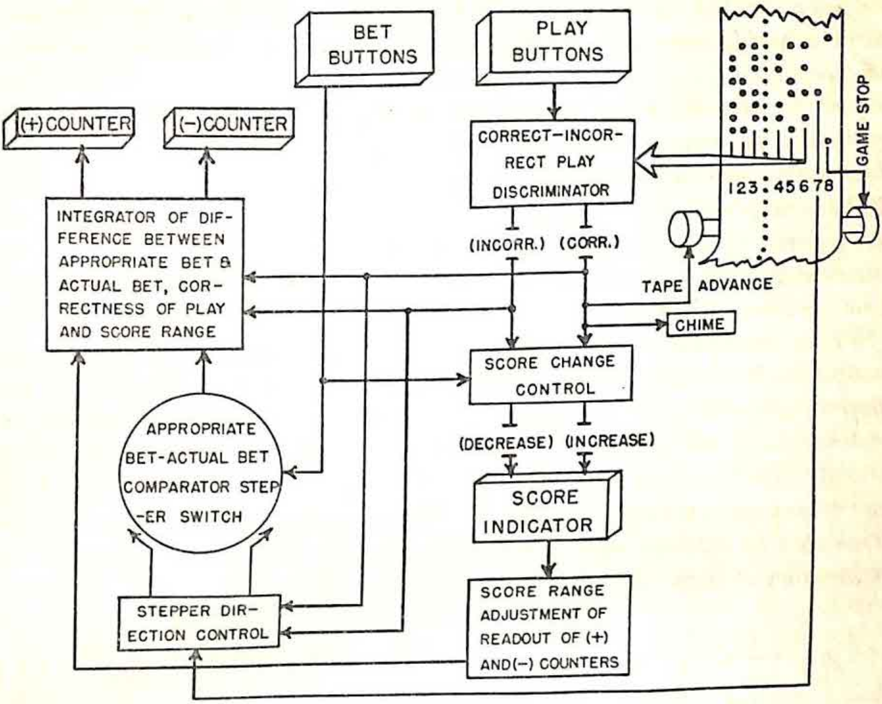
BET BUTTONS
PLAY BUTTONS
(+)COUNTER
(−)COUNTER
CORRECT−INCORRECT PLAY DISCRIMINATOR
GAME STOP
123 : 45678
INTEGRATOR OF DIFFERENCE BETWEEN APPROPRIATE BET & ACTUAL BET, CORRECTNESS OF PLAY AND SCORE RANGE
(INCORR.) (CORR.)
TAPE ADVANCE
CHIME
SCORE CHANGE CONTROL
APPROPRIATE BET-ACTUAL BET COMPARATOR STEPPER SWITCH
(DECREASE) (INCREASE)
SCORE INDICATOR
STEPPER DIRECTION CONTROL
SCORE RANGE ADJUSTMENT OF READOUT OF (+) AND(−) COUNTERS

FIGURE 2
BLOCK DIAGRAM SHOWING FUNCTIONAL INTERRELATIONSHIPS OF DIFFERENT SUBCOMPONENTS OF MACHINE

stepper-switch mechanism which thereafter adjusts the appropriate bet value one step up (or down) according to whether the subject's plays are correct (or incorrect) for the remainder of the game. The stepper switch is automatically homed to the position representing the value of 1 at the end of each game and is thereby readied for the beginning of the next game.

A hole occupying a position in channel 8 signals the end of a game, stops the cumulative timer, and causes the machine to be inoperative until the tester closes a switch reactivating the machine and timer for the next game. Red and green lights on the playing console signal to the subject when the machine is inoperative and operative.

Different games programmed on the tape loop may have different numbers of correct plays, but in each case, a number sufficient to reveal the pattern for more than one cycle of the sequence so as to give the subject an opportunity to gain (or regain) a reasonable number of score points before the game comes to an end.

Experience has shown that subjects will almost always complete a game without having made a total of more than 15 incorrect plays, most of which are accumulated during the early phase when the subject is searching for the correct pattern. However, if a subject becomes lost or has unusual difficulty in finding (or remembering) the correct pattern, a separate counter accumulates the number of incorrect plays and causes the game to be terminated after 25 have been counted so that the subject's playing time and score points will not be unduly wasted. This feature is included, since little information is obtained with respect to judgment because most subjects rarely bet no more than 1 in the above situations.

There was found to be considerable variation among different subjects with respect to their ability to conceptualize and retain a mental image of the geometric configuration of the patterns of correct play. Accordingly, a family of punched tapes was prepared so that each had games with patterns having one of eight different degrees of complexity. Several alternate tapes were also prepared for each category of complexity employing similar but not identical patterns so that subjects could be tested repeatedly without interference from recognition of previously revealed patterns.

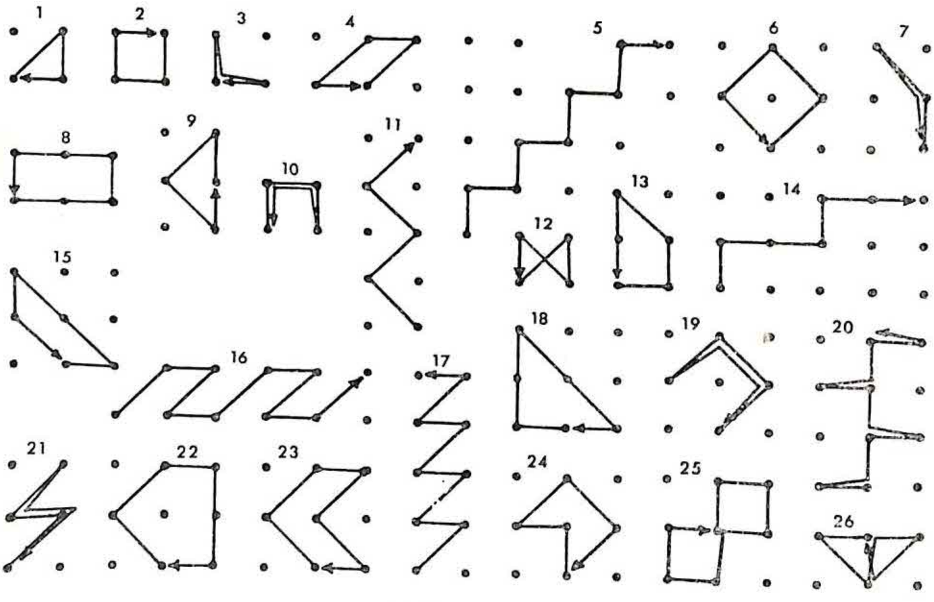

FIGURE 3

Sample Sequences of Correct Patterns of Play Illustrating Increasing Difficulty of Configuration

Arrow indicates end of a "progressive" sequence or end of one cycle of a "circuitous" pattern.

In Figure 3 are shown selected correct play pattern configurations illustrating progressive increases in degree of difficulty. The patterns shown also represent a small sampling of more than 1250 different patterns of play from which patterns were selected for originating the tapes having eight different degrees of complexity designated as tapes 1 through 8.

2. *Experimental Design, Control Study I*

Twenty-three volunteer subjects, 22 from the secretarial, technical, and medical staff (14 male, nine female, ranging in age from 20 to 53 years) were tested 10 times each, no oftener than once a day with usually more than one day intervening between tests. None was informed of the purpose of the tests and each was told to try to get the highest possible score, since each would be competing with others for small cash prizes.

A subject was not tested if he had physical pain, was emotionally upset, or had taken any psychic depressant or stimulant (coffee, tea, or caffeine-containing soft drinks excepted).

All subjects were started with one of the tapes having games with patterns of least or next to least complexity, (patterns comprising variations on the sequences illustrated as number 1 through 5 or number 1 through 9 respectively, shown in Figure 3).

In all cases with all subjects the "difficulty" of the tape was adjusted upward one degree in successive tests when it was evident from the subject's score that a given tape was too simple and not as challenging as desired. This was repeated as often as necessary until only a modest increase in score was attainable but of sufficient amount still to be motivating, or at least not discouraging. Subjects becoming aware that they were being given more difficult tapes were told that "this was being taken into account."

Most subjects for whom game complexity was progressively increased usually "plateaued" after the third to fifth test session and thereafter they were held at that level by rotating through a set of alternate tapes having approximately the same degree of difficulty with respect to complexity of game patterns. Of the 23 subjects, four reached their plateau at a degree of tape difficulty of 2, two at 3, nine at 4, two at 5, four at 6, one at 7, and one at 8. The first test of each subject was regarded as a familiarization run and the results were not included in analysis of the data.

3. *Experimental Design, Control Study II*

It was suspected that if subjects were to be made aware that they were being monitored with respect to their exhibiting over- and underconfidence by the ways in which they bet and played, such awareness could cause them to change their playing performance and thereby alter their scoring, as well as the readouts of over- and underconfidence units on the (+) and (—) counters. Accordingly, 11 subjects were asked to participate in a second series of 10 test sessions. They were selected on the basis that their performances were representative of those exhibited by the 23 subjects during the first test series. Five of the 11 subjects were told in confidence that the first round of tests had given indications of the degrees of over- and underconfidence they revealed by their manner of betting and playing and that such had been recorded for each test session. They were further told not to mention this aspect of the tests to any other person. The other six subjects were told only that another series of tests was desired to obtain additional data. Subjects of both groups were informed they would again be competing for small cash prizes.

D. Results

In Figure 4A is shown a portion of the recorded score of a test of a subject illustrating the rapid increase of score that occurs when a tape having patterns of suboptimal complexity is used. The portion of record shown in Figure 4B illustrates the gains and losses of score that occurred when the game patterns of the tape selected were somewhat more complex than optimal. The recording of score shown in Figure 4C was obtained with a subject who exhibited

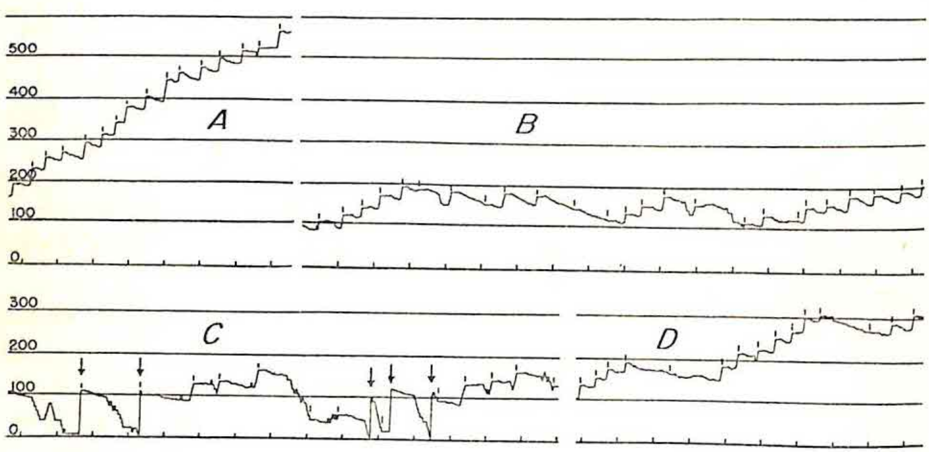

FIGURE 4
Segments of Records of Accumulated Score from Tests of Four Different Subjects
Ordinate—score points; abscissa—time in minutes. Each vertical mark above score recorded indicates end of one game. Further description in text.

a markedly erratic betting performance and very frequently made runs of high bets despite the evidence of their being losing bets. It may be noted that on four occasions the subject was "cleaned out" and on five occasions (see arrows) the subject had to be given an additional one hundred score points so that he might continue to play. This subject was not included in the present study. The segment of record shown in Figure 4D illustrates three instances in which a subject encountered difficulty finding the correct sequence or forgot his place in a sequence and the game was automatically terminated after 25 incorrect plays.

Although score may at times be a contributing indicator with respect to the quality of judgment, it appears generally to be a quite poor one. In Figure 5A and 5B are plotted score and also cumulative units of over- and underconfidence for subject No. 20 who was given the identical test 14 days apart. During the first test (A) he lost score points, largely due to his not being able to find the correct patterns and rash betting. On the second test (B) his score

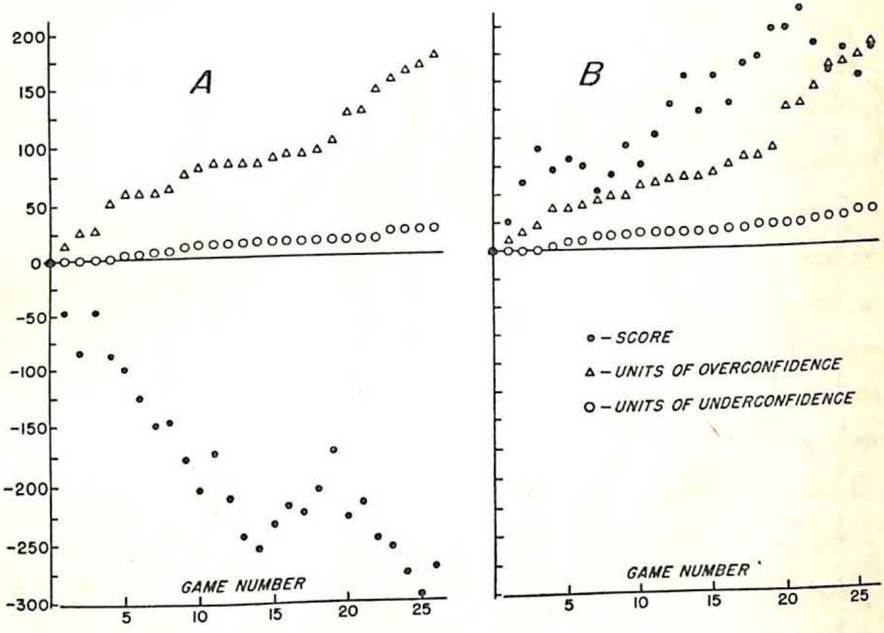

FIGURE 5
PLOTS OF ACCUMULATED SCORE AND UNITS OF OVER- AND UNDERCONFIDENCE FOR ONE SUBJECT GIVEN SAME TEST TWO WEEKS APART
Symbols identified in right lower quadrant. Further description in text.

increased moderately, due to improvement in his ability to visualize the correct patterns, but he was still inclined to bet too high too soon. It may be seen that in both tests his "inappropriate" betting is reflected in the substantial increases in (+) units with only moderate accumulation of (—) units. Most importantly, the amounts of increase in both were essentially the same in the two tests, while the changes in score were directionally opposite. Although his final scores varied widely among the other eight test sessions, the (+) and (—) readouts varied only moderately.

In Figure 6 are plotted final scores and units of over- and underconfidence for the last nine of 10 consecutive test sessions with subjects Nos. 22 and 2 who manifested widely different performances with respect to indications of judgment. Subject No. 22 (A) consistently exhibited a high degree of over-

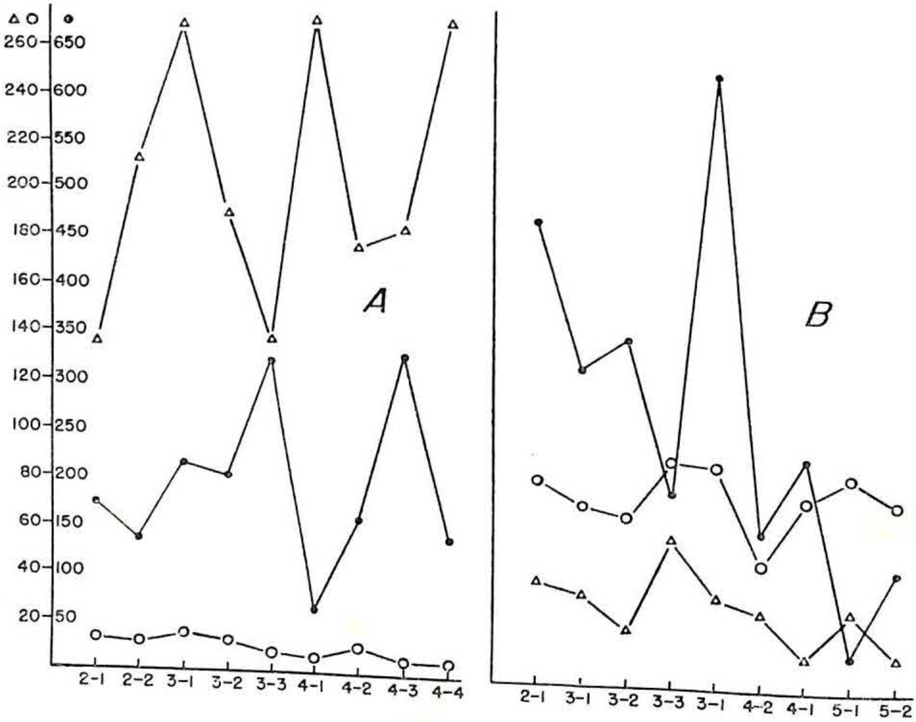

FIGURE 6

Plots of Score (Solid Dots), Units of Overconfidence (Triangles), and Units of Underconfidence (Open Circles) for Each of Nine Consecutive Test Sessions for Subject 22 (A) and Subject 2 (B)

Ordinate—scale for score points and units. Abscissa—first digit is the tape number indicating degree of complexity of test patterns; second digit indicates number of alternate equivalent tape used.

confidence despite his relatively low scoring. Subject No. 2 (B) consistently exhibited a preponderance of underconfidence (or conservatism?) and achieved a 44-percent higher average score than subject No. 22 despite his apparent underconfidence but perhaps even more likely because of his manifesting very little overconfidence.

In Table 2 are presented the results obtained with respect to average number of overconfidence (+) and underconfidence (—) units recorded and average point score attained by each of the 23 subjects. Also indicated by a number (2 through 8) is the level of difficulty of the patterns encoded on the tape used in the last test of each subject.

TABLE 2
RESULTS OBTAINED WITH RESPECT TO AVERAGE NUMBER OF OVERCONFIDENCE (+) AND UNDERCONFIDENCE (—) UNITS RECORDED AND AVERAGE POINT SCORE ATTAINED BY EACH OF THE 23 SUBJECTS

S#	Sex	Avg. (+) units	Avg. (—) units	Avg. score	Tape # last test
1	M	54	54	343	4
2	M	34	80	285	5
3	M	54	65	317	4
4	F	97	25	478	6
5	F	52	80	218	2
6	F	87	48	470	2
7	M	87	48	271	8
8	M	67	70	262	7
9	M	96	41	403	5
10	M	125	26	383	6
11	F	125	29	261	4
12	M	89	69	126	6
13	F	86	75	292	3
14	F	143	19	396	4
15	F	88	76	69	2
16	F	85	80	383	4
17	M	122	46	223	6
18	M	156	20	377	6
19	M	150	55	215	3
20	M	161	44	100	2
21	M	185	38	127	4
22	M	204	25	198	4
23	F	236	5	364	4

A more revealing presentation of the relationship between over- and underconfidence and score is shown in Figure 7. When plotted against each other, manifest overconfidence and underconfidence tend to be inversely related, while point score appeared to have no correlation with either.

The results of Control Study II in which five of 11 subjects were made

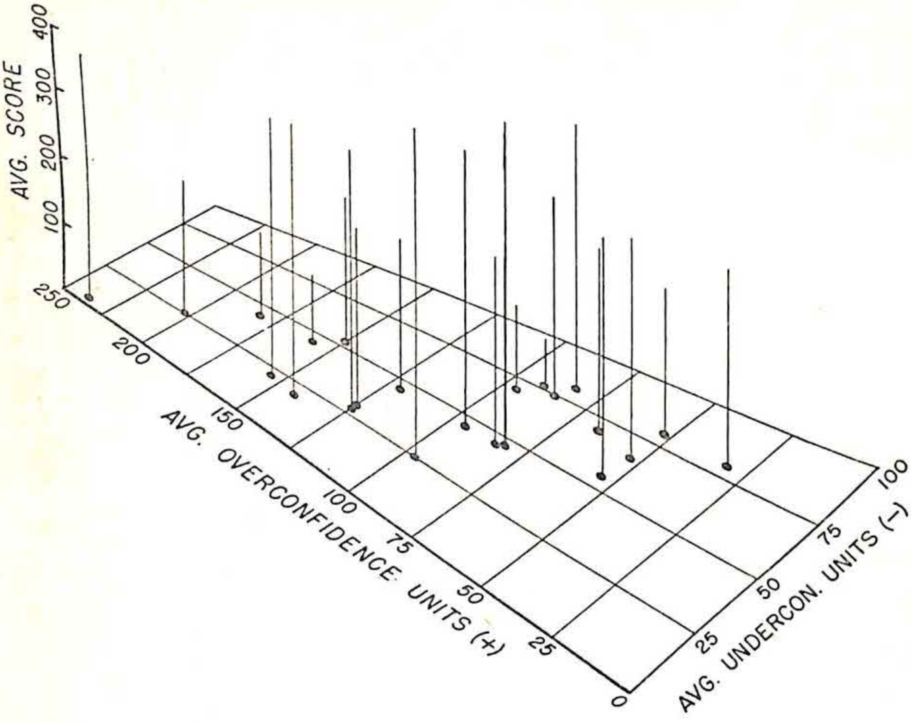

FIGURE 7
PLOT OF THE RELATIONSHIP BETWEEN THE AVERAGE NUMBER OF OVER- AND UNDERCONFIDENCE UNITS RECORDED FOR EACH OF 23 SUBJECTS (DOTS) AND AVERAGE SCORE MADE (INDICATED BY HEIGHTS OF LINES ABOVE DOTS)

aware of their being monitored with respect to the degree to which they were exhibiting over- or underconfidence are summarized in Figure 8A. Results with six subjects who were unaware they were being monitored are shown in Figure 8B.

E. DISCUSSION

The method and machine described herein and employed for testing normal subjects has provided data with respect to subject performance that appear to reveal different qualities of judgment-making among subjects as reflected in the appropriateness of their expressions of confidence in their decisions that were made during tests involving a game situation. The quality of judgment, as herein defined, is revealed and quantified in a general way as being a function of the degree to which a subject appropriately indicates the

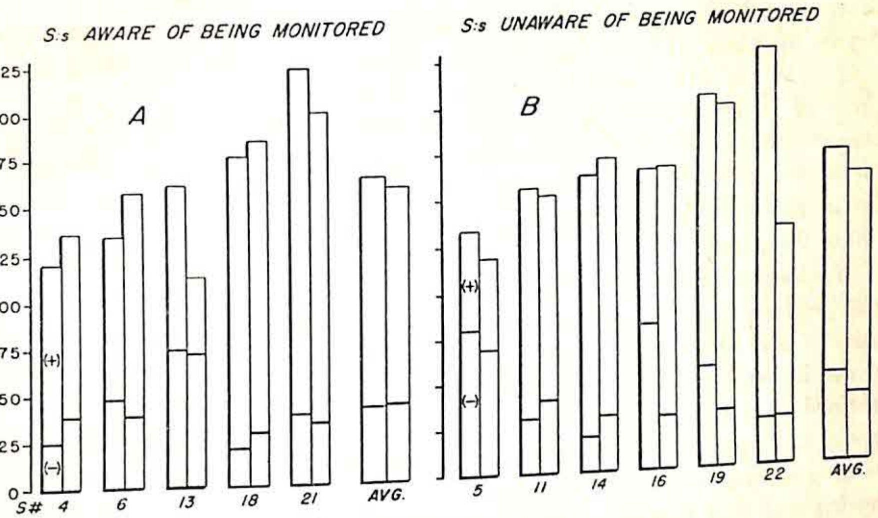

FIGURE 8

BAR GRAPHS SUMMARIZING RESULTS OF TWO EXPERIMENTS ON EACH OF 11 SUBJECTS

For each subject left bar of pair indicates average units of over- (+) and under-confidence (—) and their sum (height of bar) for the last 9 of 10 test sessions; right bar of pair indicates the same measure for all 10 test sessions of second experiment on same subjects when Group A was aware and Group B was unaware that their performance was being monitored. Ordinate units of (+), (—), and sum. Further description in text.

probability that each of a succession of his plays will be correct, considering the total amount and relevance of information known to have been made available to him before each play.

There were observed to be marked differences in the degree to which different subjects exhibited overconfidence and/or underconfidence in estimating their chances of success in winning score points. There was no obvious correlation between the amount of over- or underconfidence displayed or the ratio of one to the other and the scores attained. It also appears that the number and magnitude of influences that determine betting and playing performance of an individual remain essentially unchanged over a period of many days.

If boredom, frustration, lack of motivation, or other emotional reactions to repeated testing did develop, they did not appear to modify significantly the quality of judgment manifested with respect to selection of appropriate bets and manner of playing.

There is impressive evidence that the method herein described estimates only one aspect of human judgment in that Subject No. 1, who manifested the least over- and underconfidence while attaining a high score, had been charged with six criminal offenses ranging from public intoxication to second degree burglary with five jail or prison sentences over the last ten of his 24 years. On the other hand, Subject No. 23, who regularly exhibited high degrees of overconfidence, is a highly responsible and dependable person who consistently and efficiently carries out a variety of technical assignments with meticulous care. Interestingly, she is a frequent poker player, admits to making inappropriately high bets, loses regularly, but continues to play because she "likes the game."

In Control Study II in which 11 subjects were given a second round of 10 test sessions each, there is further evidence that most subjects maintain relatively unchanged their respective manifest degrees of over- and underconfidence in betting. (See Figure 8B.) Moreover, the five subjects who were informed that the appropriateness of their betting had been and again was going to be monitored exhibited unexpectedly little change in their manner of betting during the second series of tests (Figure 8A). Although it had been anticipated that betting might become more conservative, this study suggests that most subjects tend to maintain the same manner of betting and playing within the context of the present test even when they are aware that the appropriateness of their betting is being monitored in terms of its exhibiting inappropriate over- and underconfidence.

F. SUMMARY AND CONCLUSIONS

A method and machine have been described for estimating objectively one aspect of human judgment in terms of manifest inappropriate overconfidence and underconfidence. In a game situation with the goal being to increase score points, the subject selects possible correct choices of play after indicating by the size of his bet, the amount of confidence he feels that his next play will be correct. By perceiving which plays are correct and which are incorrect, it becomes possible, after some number of correct plays, for the subject to deduce the probable identity of a correct *pattern* of plays which can be recognized as a sequence that delineates a geometric trail or figure. The machine senses the number of correct plays and is programmed to set the size of the bet that would be "appropriate" for the subject to make before each play, depending upon the number and continuity of the subject's correct plays. For each play the "appropriate bet" is matched against the subject's actual bet and any mismatch is electrically translated into recorded units of overconfidence or underconfidence depending upon whether the subject's bet was greater than, or less than, the "appropriate bet." The number of units of both are accumulated on separate counters. Subjects were permitted to play 26 games (each having a different geometric pattern of play) or for 20 minutes in each test session.

Twenty-three normal subjects tested for 10 sessions each over a four-week period showed substantial differences among subjects, but individual subjects generally exhibited no systematic change in the number of over- and underconfidence units recorded per test after the first familiarization test session. A second set of 10 tests was given to 11 of the 23 subjects after five were told and six were not told that their manner of betting had been and would again be monitored with respect to its reflecting inappropriate over- and underconfidence. Despite awareness or lack of awareness of what was being monitored, there was no appreciable change in betting performance.

It should be emphasized that the method does not purport to indicate whether a subject's judgment is good or bad in any absolute sense, even in the context of the procedure as performed. However, the control observations reported here would suggest that the test method and procedure may be a suitable means for detecting changes in one aspect of human judgment that may result from administration of psychotropic drugs or other modalities.

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DISSONANCE *VERSUS* CONTRAST IN AN EGO-INVOLVED SITUATION WITH DISCONFIRMED EXPECTANCIES*

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A. INTRODUCTION

Festinger (2) proposed that the existence of incompatible cognitions is a motivating force which impels the organism toward attaining cognitive balance. Carlsmith and Aronson (1) attempted to generalize Festinger's theory to any situation involving an expectancy. They suggested that dissonance is aroused whenever an event occurs which disconfirms a strong expectancy. They had their subjects taste and rate a random order of sweet and bitter solutions. Expectations pertaining to whether the solution would be sweet or bitter were induced through subtle hand signals. By giving inappropriate signals, the experimenters attempted to disconfirm the subject's expectancies, which according to dissonance theory would produce unpleasant ratings. It was reported that when the subjects' expectancies were disconfirmed, both for sweet and bitter solutions, the subjects judged the solutions to be more unpleasant than when they had no basis for an expectancy.

Mace (3) suggested that the use of one rating scale for both pleasant and unpleasant solutions would allow for a more valid hedonic judgment since this procedure would allow the subjects to judge sweet solutions as being more pleasant than bitter solutions. Also, Mace criticized Carlsmith and Aronson for having an unreliable agent (saccharine) as the basis for sweet solutions. He re-examined the affective judgment situation, using 7-Up and quinine water for pleasant and unpleasant solutions respectively, and using color of the solution as the basis for establishing expectancies. He reported that when expectancies were disconfirmed a contrast effect was demonstrated. That is, when a subject expected a solution to be pleasant and it was perceived as being unpleasant, it was judged more unpleasant than when there was no basis for an expectancy. When the subject expected the solution to be unpleasant and it was perceived as being pleasant, he judged it to be more pleasant than when

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there was no basis for expectancy. These results do not support the idea that dissonance was aroused in this hedonic judgment situation. These results were interpreted within the framework offered by Sherif and Hovland (4) in their discussion of assimilation and contrast effects in attitude change. According to Sherif and Hovland, if a stimulus is perceived as being quite discrepant with a reference, a contract effect occurs; i.e., there is a tendency to push the judgment farther away from the reference.

Mace (3) made no attempt to provide any kind of "pay-off" for his subjects having their expectancies confirmed. Carlsmith and Aronson (1) paid their subjects $.50 for correct guesses and "charged" them $1.00 for being incorrect. Therefore, there may have been a difference of involvement in the expectancy situation that led to the differences in results of the two studies. Also it occurred to these authors that there may be a difference between the hedonic nature of a stimulus and the hedonic reaction to the total situation. For example, with a disconfirmed expectancy, one might find that the general feeling toward the whole situation of making a judgment is more pleasant or unpleasant than the hedonic perception of the stimulus itself. It was thought that the difference between the two above reports might be that in one the subjects were expressing a contrast reaction to a stimulus situation and in the other a dissonance reaction based on their feeling tone in the total judgment situation. These two possibilities were incorporated in the present study: Ego-involvement as defined by Sherif, Sherif, and Nebergall (5), and the use of two hedonic rating scales, one for the stimulus reactions and one for the feeling tone reactions. The following specific patterns of change in ratings were investigated in this study:

1. Contrast: if the subject expects an experience to be pleasant but it is unpleasant, the experience would be rated as more unpleasant than if he had no expectancy. If the experience is expected to be unpleasant but it is pleasant, it would be rated as more pleasant than if he had no expectancy.
2. Dissonance: because any disconfirmed expectancy would be uncomfortable, disconfirmed expectancies for both pleasant and unpleasant experiences would be rated as more unpleasant than if there was no expectancy.

The separation of stimulus ratings and feeling tone ratings, the disconfirmation of both pleasant and unpleasant expectancies, and the use of both an ego-involved group and a noninvolved group permits the examination of a large number of hypotheses regarding specific combinations of effects. However, for the purposes of this study, the following were the pertinent basic hypotheses:

1. The basic reaction is a contrast effect and ego-involvement simply increases the strength of the reaction. Both ego-involved subjects and noninvolved sub-

jects will show a contrast effect on both the stimulus scale and the feeling tone scale, but the reaction will be greater for the ego-involved subjects.

2. Dissonance requires, or is more likely to occur under, conditions of ego-involvement. On both scales the ego-involved subjects will show a dissonance effect, while noninvolved subjects will show a contrast effect.

3. Dissonance applies only to judgments involving personal feelings of commitment. Both the ego-involved and noninvolved subjects will show a contrast effect in their stimulus ratings and a dissonance effect in their feeling tone ratings.

B. METHOD

Students enrolled in introductory psychology courses at the University of Oklahoma and the University of Missouri—Rolla were given the task of evaluating nine statements pertaining to the importance of grades in college (see Table 1). In accordance with a procedure established by Sherif, Sherif, and Nebergall (5), a total of 128 students were given a complete set of the nine statements copied on each of four sheets of paper assembled into a booklet. On the first sheet the subjects were given the following instructions:

TABLE 1

STATEMENTS USED FOR SUBJECT SELECTION

a. There is no doubt that obtaining good grades is the most important aspect of college.
b. Obtaining good grades is one of the most important aspects of college.
c. Obtaining good grades is often a very important aspect of college.
d. Obtaining good grades is sometimes a very important aspect of college.
e. It is difficult to say whether or not obtaining good grades is an important aspect of college.
f. Obtaining good grades is sometimes not a very important aspect of college.
g. Obtaining good grades is often not a very important aspect of college.
h. Obtaining good grades is one of the least important aspects of college.
i. There is no doubt that obtaining good grades is the least important aspect of college.

> Below are some statements expressing various positions on the matter of grades in college.
>
> 1. Please read all the statements *carefully* first before making any marks on this page.
> 2. Now that you have read carefully all of the statements *underline* the *one* statement that comes closest to your position on this matter.

On the second page the subjects were instructed:

> The statements below are the same as those on the preceding page.
> 1. Please read all the statements carefully again before making any marks on this page.
> 2. On the first page, you underlined the one statement that was most acceptable to you. On this page, CIRCLE the letter of any other statement or statements that are acceptable to you.

On the third page they were instructed:

> The statements below are the same as those on the two preceding pages.
> 1. Please read through the statements again.
> 2. Now that you have read through the statements again, CROSS OUT the ONE statement that is most OBJECTIONABLE from your point of view.

On the fourth page the subjects were instructed:

> The statements below are the same as those on the first three pages.
> 1. Read through the statements again.
> 2. On the preceding page you indicated the statement that you disagreed with the most. On this page CIRCLE the letter of any other statement or statements that you also find objectionable.

The position checked on the first two pages indicated the subject's latitude of acceptance, while those positions checked on the last two pages indicated his latitude of rejection.

On the basis of the student's evaluation of the nine statements, 10 ego-involved males, 10 ego-involved females, 10 uninvolved males, and 10 uninvolved females were selected as subjects for the experiment. In order for a subject to be judged to be ego-involved in this issue, he had to indicate rejection of at least 50 percent of the statements. In order for a subject to have been judged to be uninvolved, he had to be noncommitted on at least 50 percent of the statements. This criterion is stated by Sherif, Sherif, and Nebergall (5) as an often used method in judgment studies. In addition, for the ego-involved subjects, only those who indicated being involved with obtaining good grades were selected. That is, only those subjects who accepted as their own position either statement a, b, or c and rejected at least 50 percent of the other statements were selected.

Two standard soft drinks (7-Up and quinine water) were used as the pleasant and unpleasant solutions respectively. Mace (3) reported that 7-Up was consistently rated as pleasant and quinine water was consistently rated as unpleasant. The color of the stimulus solutions was used to induce expectancies on the part of the subjects. One drop (measured from an eyedropper) of either yellow or green food coloring per 12 oz. of soft drink gave a distinguishable color to either soft drink.

For rating the hedonic qualities of the solutions, each subject was given a form composed of 11 horizontal lines 150 mm long. These lines were anchored at one end by the term PLEASANT, at the other end by the term UNPLEASANT, and in the middle by the phrase NEITHER PLEASANT NOR UNPLEASANT. The first line, which was twice as thick as the others, was labeled STANDARD, while the remaining lines were consecutively numbered 1 through 10.

The order of presentation of the solutions can be seen in Table 2. Mace(3) reported that there were no differences in the ratings of the standard solutions due to the order of tasting, nor were there any differences in rating of the standard solutions due to the sex of the subject, however sex was retained as a variable in view of the possibility of sex differences in the effect of ego-involvement and in the feeling tone reactions as separate from the stimulus judgments.

TABLE 2
ORDER OF PRESENTATION OF SOLUTIONS

Group	Standards		Experimental solutions		
		Trial	1	2	3
1E	7y	Qg	7y	7y	$\underline{\text{Qy}}$
1N	7y	Qg	7y	7y	$\underline{\text{Qy}}$
2E	7y	Qg	Qg	Qg	$\underline{\text{7g}}$
2N	7y	Qg	Qg	Qg	$\underline{\text{7g}}$

Note: Inappropriately colored solutions (disconfirmed expectancies) are underlined. The abbreviations used are: E—ego-involved group, N—non-involved group, 7y—7-Up with a yellow color, 7g—7-Up with a green color, Qg—quinine with a green color, Qy—quinine with a yellow color.

Four groups of subjects participated in the experiment. Group 1E (five ego-involved males and five ego-involved females) and 1N (five uninvolved males and five uninvolved females) both experienced a disconfirmed expectancy of pleasantness on the third trial, while Groups 2E (five ego-involved males and five ego-involved females) and 2N (five uninvolved males and five uninvolved females) both experienced a disconfirmed expectancy of unpleasantness on the third trial.

The stimulus solutions, as well as the water to be drunk between solutions, were kept at constant room temperature. Fresh mixtures of solution and fresh water were used each day. Subjects received exactly two cubic centimeters of solution on each trial but were allowed to drink as much water between solutions as they desired. The containers for the solutions were white, opaque, half-ounce paper cups. Also, subjects were asked to refrain from smoking during the experiment. Subjects participated individually.

Each subject was seated at a desk facing the experimenter. Between them was a row of 10 cups containing the solutions. Although only the first three were used in the experiment, 10 were displayed to balance for color. In front of the row of 10 cups were two cups containing the standard solutions. The following instructions were given to each subject:

> As you may or may not know, one of the things that we are concerned with in the study of human behavior deals with the stable characteristics of individual people. That is, because of certain characteristics, people who respond in one way in one situation will respond in a similar way in another situation.
>
> One of the things that research in this area has shown us is a relationship between the ability to make sensory discriminations, such as being able to recognize the differences in tastes, and the ability to make intellectual discriminations. By intellectual discriminations, I'm referring to the ability to recognize the differences between alternatives such as the different answers on a multiple choice exam in college. Of course, the ability to make these discriminations directly affects our grades.
>
> The two solutions that are immediately in front of you are standard solutions which you will use as the basis for your judgments of the other solutions. I want you to taste and rate each of these two standards on how pleasant or unpleasant it tastes to you on this form. Starting with this one (7-Up), you may taste or sip these standards as often as you need before making your rating. However, rinse your mouth with this water between solutions so that the taste of one does not interfere with the taste of the next one. Make a slight perpendicular slash on the scale line labeled standard to indicate your rating of each of these solutions.

Each subject was supplied with another rating form, of the same design as the one described above. However, the second rating form was labeled FEELING TONE. The subjects were then told:

> On this second rating form, I want you to indicate how pleasant or unpleasant you feel after each trial—i.e., after each tasting of a solution. This is because previous research has not made the distinction between pleasant and unpleasant taste and pleasant and unpleasant feelings. For each solution, make your rating on the taste form and then make your rating of the feeling tone form.

When both of the standard solutions were rated, as well as the subject's feeling tone after judging each standard, the experimenter (using a ruler) extended the standard solution ratings and the standard feeling tone ratings down through the remaining scale lines. The subjects were then told:

> I am extending your rating of these two standard solutions and feeling tone ratings down through the other lines so that you will have an

> accurate reference to these when rating the sample solutions. For the same reason I am extending your ratings of how pleasant you feel at this moment in the experiment. You are, of course, free to go inside or outside of these lines in your subsequent ratings.
>
> These 10 sample solutions are slightly different formulations of the standards that you have just rated. For each of these, take the entire amount in your mouth, hold it there briefly and then rate it on the appropriate line below the standard. Line 1 refers to sample 1, line 2 to sample 2, etc; after you have rated each sample on the taste form, then rate your general feeling on the other form.

The experiment was terminated for all subjects after the third trial rating. They were asked to fill out a demand characteristic questionnaire, were told the nature of the experiment, and were asked to refrain from telling any other students about the experiment.

Any subject who formulated a hypothesis equivalent to the experimental one was to have been disqualified. However, it was not necessary to discard any subjects on the basis of the questionnaire.

This questionnaire also served as an index of credibility. One of the questions that the subjects were asked was "Did the thought ever occur to you during the experiment that we were not interested in correlating taste with intellectual ability?" All of the subjects responded "no" to this question, which indicated that they accepted the relationship.

C. RESULTS

The basic problem examined in this study was: Do ego-involved subjects respond differently than noninvolved subjects when an expectancy has been disconfirmed in an affective judgment situation and, if they do, is the difference dependent on whether the feeling tone or the stimulus characteristics are being evaluated? Therefore, the critical comparisons were the third trial ratings of the ego-involved subjects with the third trial ratings of the noninvolved subjects. As can be seen in Table 2, the third trial was designed to disconfirm an expectancy of unpleasantness (green 7-Up, Groups 2E and2N), or to disconfirm an expectancy of pleasantness (yellow quinine, Groups 1E and 1N).

The rating scale lines were 150 mm long and the standard ratings (ratings without an expectancy) were indicated on each scale line. The differences between the third trial ratings and the standard ratings for the same solution were determined for each subject, measured in millimeters. In recording the rating, change toward the pleasant end of the scale was given a plus sign and change toward the unpleasant end of the scale was given a minus sign. As has been previously stated, Mace (3) reported that there were no differences in rating of the standard solutions due to order of presentation or sex of subject.

The mean stimulus ratings of trial 3 were Group 1E (-21.7), Group 2E (+22.9), Group 1N (-11.3), and Group 2N (+11.5).

With the scaling techinque used in this study, a contrast effect would be indicated by changes away from the neutral point of the scale; dissonance would be indicated by changes in rating toward the unpleasant end of the scale—i.e., with negative changes. The mean changes in rating on trial 3 are in the direction of a contrast effect. With the method of scoring used in this experiment, if a pure contrast effect existed and was not dependent on the type of expectancy disconfirmed, the positive and negative changes in each involvement group would cancel so that the mean change for each group would approximate zero and no differences between the two groups would show. Therefore, an analysis of variance was performed on these change scores, reversing the signs of groups 1E and 1N, and separating the data by Involvement, Expectancy, and Sex. As can be seen in Table 3, the difference between involvement groups yielded a significant F ratio ($F = 12.9$, $p < .01$). None of the other differences were significant.

TABLE 3
ANALYSIS OF VARIANCE OF CHANGES IN STIMULUS RATING ON TRIAL 3, REVERSING THE SIGNS OF GROUPS 1E AND 1N

Source	*SS*	*df*	*MS*	*F*	*p*
Involvement (I)	1188.1	1	1188.1	12.9	.01
Expectancy (E)	5.0	1	5.0		
Sex (S)	14.4	1	14.4		
(I) × (E)	2.5	1	2.5		
(I) × (S)	1.9	1	1.9		
(E) × (S)	.9	1	.9		
(I) × (E) × (S)	3.8	1	3.8		
Error	2944.0	32	92.0		

Thus there is a clear indication of a *contrast* effect in the reactions to the stimulus characteristics; the degree of the effect depends on the degree of ego-involvement. There is no evidence that the type of expectancy disconfirmed affects the magnitude of the contrast reaction. The very small portion of variance associated with the Involvement × Expectancy interaction indicates that the difference between the involvement groups is in no way dependent on the type of expectancy disconfirmed.

If dissonance had been present in any detectable degree, there would have been significant variation associated with either or both the Expectancy (E) factor and the Involvement × Expectancy (I × E) interaction. Therefore,

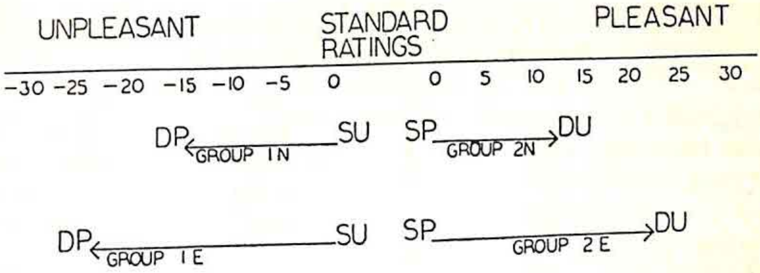

FIGURE 1

OBTAINED CHANGES ON THE STIMULUS RATINGS

SP—standard pleasant rating, SU—standard unpleasant rating, DP—disconfirmed pleasant expectancy, DU—disconfirmed unpleasant expectancy.

as can be seen in Figure 1, there seems to be a relatively pure contrast effect in the hedonic ratings of the stimulus characteristics; i.e., the changes are away from the neutral point of the scale.

Although the significance of the Involvement (I) factor indicates that the ego-involved group changed more than the noninvolved group, it does not indicate whether or not the changes in the noninvolved groups were significant. The appropriate *t* tests were performed on the means for Groups 1N ($\overline{X} =$ -11.3) and 2N ($\overline{X} = +11.5$). The resulting *t* tests were significant at the .05 level of confidence, indicating that disconfirmation of an expectancy produces a contrast effect even in noninvolved subjects.

It should be noted that a control group used in Mace (3) which received the same treatment as groups 1N and 2N, with the exception that no expectancy was aroused, showed no significant change in stimulus ratings from the standard ratings. This indicates that the change in stimulus ratings in groups 1N and 2N was due to the disconfirmed expectancy rather than an abrupt change in stimulus presentations (i.e., from 7-Up to quinine water or vice versa).

The changes in feeling tone ratings were obtained in the same manner described above for the changes in ratings for the solutions. The mean ratings on this scale after a disconfirmed expectancy were Group 1E (-37.1), Group 2E (+29.0), Group 1N (-8.3), and Group 2N (+6.4). An analysis of variance was performed on these change scores, reversing the signs of Groups 1E and 1N, and separating the data by Involvement, Expectancy, and Sex. As can be seen in Table 4, the Involvement factor yielded a significant *F* ratio ($F = 60.1$, $p < .01$). As with the analysis of the stimulus ratings, the Involvement factor (I) was the only significant one. However, the *F* ratio for the Expectancy factor (E) showed some variation. To the extent that this nonsignificant variation may be meaningful, it would indicate some tendency for the type of

TABLE 4
ANALYSIS OF VARIANCE OF FEELING TONE CHANGES IN RATING ON TRIAL 3, REVERSING SIGNS OF GROUPS 1E AND 1N

Source	*SS*	*df*	*MS*	*F*	*p*
Involvement (I)	6604.1	1	6604.1	60.1	.01
Expectancy (E)	273.0	1	273.0	2.3	NS
Sex (S)	22.7	1	22.7		
(I) × (E)	95.4	1	95.4		
(I) × (S)	14.8	1	14.8		
(E) × (S)	5.2	1	5.2		
(I) × (E) × (S)	7.1	1	7.1		
Error	3493.2	32	110.0		

expectancy disconfirmed to influence the amount of change in ratings. Inspection of the four group means shows that changes toward the unpleasant end of the scale were somewhat larger than those toward the pleasant end. This would be consistent with a small dissonance effect (see Figure 2). Therefore, there is some reason to suspect that, although the major effect in the feeling tone ratings is a contrast effect, there may be a small, but not statistically significant dissonance effect. The Involvement × Expectancy (I × E) interaction again produces slightly less than chance variation, so there seems to be no evidence that the two involvement groups are reacting differently as far as the contrast-dissonance combination is concerned.

Again, the appropriate *t* tests were performed to determine whether or not the mean changes in rating of the noninvolved groups were significant. Neither

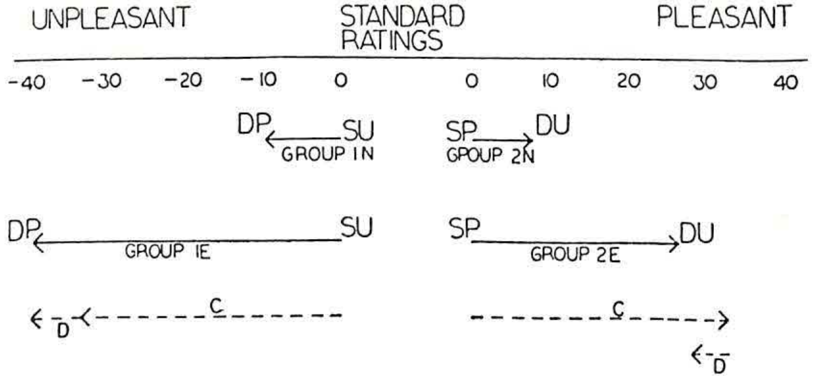

FIGURE 2
OBTAINED RATING CHANGES ON FEELING TONE SCALE

SU—standard unpleasant rating, SP—standard pleasant rating, DP—disconfirmed pleasant experience, DU—disconfirmed unpleasant experience, c—presumed pure contrast effect, d—presumed small dissonance effect.

comparison showed a significant difference. Thus lack of involvement reduces feeling tone changes to nonsignificance, while the presence of ego-involvement boosts feeling tone changes to a highly significant level.

Inspection of the feeling tone means indicated a possible stronger reaction with a disconfirmed pleasant experience than with a disconfirmed unpleasant experience. As can be seen in Table 5, the mean of Group 1E was significantly different from the mean of Group 2E ($p < .05$), while the difference between the means for Groups 1N and 2N was not significant. Although this is actually an (I)×(E) interaction test, it is somewhat more informative than the (I)×(E) interaction in the analysis of variance. The latter, which would ordinarily indicate whether or not an interaction was present, is in fact a purified term from which the effects of the overall expectancy factor confounded with the interaction effect, allows them to combine to show a small significant effect.

TABLE 5

Comparison of Intergroup Means on Feeling Tone Scale

Groups	Comparison means	t	p
1E *vs.* 2E	(37.1) *vs.* (29.0)	1.92	.05
1N *vs.* 2N	(8.3) *vs.* (6.4)	.9	—

Thus the analysis of the feeling tone ratings shows a strong contrast effect, with probably a small amount of dissonance, for the ego-involved groups. For the noninvolved groups, the changes were in the same direction as for the ego-involved groups, but were not significant.

Of the hypotheses stated earlier in this report, the first, that the effect is a contrast effect and that ego-involvement simply increases the strength of the effect, is clearly supported for the stimulus ratings and seems to be a major factor on the feeling tone ratings. No support for hypothesis two was found. Some small partial support was found for hypothesis three, that dissonance applies only to judgments involving personal feelings of commitment.

D. Discussion

The third trial rating changes in this experiment demonstrate that the subjects experienced a contrast effect when their expectancies were disconfirmed. If a person expects an experience to be pleasant and it is unpleasant, he perceives it as being more unpleasant than if he had no basis for an expectancy. If he expects an experience to be unpleasant and it is pleasant, he perceives it as being more pleasant than if he had no basis for an expectancy. These results are in line with those reported by Mace (3). The results obtained in the present study gave no evidence of a dissonance effect on the stimulus ratings, although there is some indication of a small dissonance effect on the feeling tone scale.

The present study also indicates that if a subject is ego-involved, he will experience a significantly stronger contrast effect than a subject who is not involved in the situation. Also, the pattern of judgment is quite symmetrical on the stimulus ratings. That is, the contrast effect to the stimulus characteristics did not depend on the expectancy which was disconfirmed. The contrast effect with a disconfirmed pleasant experience was of the same intensity as the contrast effect with a disconfirmed unpleasant experience. There were no differences in male and female subjects in terms of the intensity or direction of the reaction.

Sherif and Hovland (4) offer a framework for assimilation and contrast effects in attitude change. In referring to the anchors that individuals use in making judgments, they state: "The use of anchors within the stimulus series is functionally equivalent to the use of a standard stimulus in classical psychophysical methods" (4, p. 51). The standard solutions used in the present experiment can be viewed as the anchors from which judgments of succeeding solutions were made.

According to Sherif and Hovland (4) an anchor acts as a reference from which the determination of either an assimilation or contrast effect is made when viewing succeeding judgments. If the stimulus is perceived as being similar to the anchor, there is a tendency to draw the judgment closer to the anchor—i.e., to assimilate toward the anchor. On the other hand, if the stimulus is perceived as being dissimilar to the anchor, a contrast effect occurs and the judgment is pushed farther away from the anchor.

Sherif and Hovland (4) postulate two forces as potentially affecting each judgment: a contrast effect to push the rating away from its respective anchor and an assimilation effect to pull the rating toward its respective anchor.

In the present study, when an expectancy was disconfirmed, such a contrast effect was indicated by the ratings being significantly beyond their respective anchors and toward the extremes of the scale.

Sherif, Sherif, and Nebergall (5, p. 40) state that a number of recent studies, as well as their own research, indicate that an individual who is ego-involved will tend to have a stronger contrast effect than noninvolved individuals. The above research is primarily dealing with discrepant communication in the pattern of attitudes and attitude change. An individual who is highly ego-involved in an attitude will tend to view any communication that is not similar to his own position in an exaggerated contrast reaction when compared with judgments of people who are relatively noninvolved (5, pp. 236-237).

The same type of phenomenon seems to be occurring in the present experiment. That is, the ego-involved subjects showed a stronger or exaggerated contrast effect when their expectancies were disconfirmed, compared to the noninvolved subjects. The perception of the disconfirmed expectancy can be conceived of as a form of communication; i.e., the individual is receiving some information about the situation. Apparently, those who are ego-involved perceive this information as being more discrepant from their anchor or reference than those who are not involved.

The analysis of the feeling tone ratings indicate that there is also a strong contrast effect in feeling tone for ego-involved subjects when an expectancy is disconfirmed. However, this analysis indicated a difference in intensity of the reaction, depending on which expectancy was disconfirmed. That is, if an individual expects an experience to be pleasant and it is unpleasant, the magnitude of his unpleasant feeling is greater than the magnitude of his pleasant feeling when he expects an experience to be unpleasant and it is pleasant. This could indicate a combination of dissonance and contrast. The contrast effect tends to pull the ratings toward the extremes, while a dissonance effect tends to pull the ratings toward the unpleasant end of the scale. As can be seen in line 3 of Figure 2, a combination effect would follow a pattern such as that of the ego-involved subjects' ratings on the feeling tone scale. That is, the disconfirmed pleasant reaction would be quite large, since both contrast and dissonance would be pulling the rating toward the unpleasant end of the scale. The disconfirmed unpleasant reaction would be significantly smaller than the disconfirmed pleasant reaction because the contrast effect would be pulling the rating toward the pleasant end of the scale while the dissonance effect would be pulling the rating toward the unpleasant end of the scale.

Some support is given to the idea of a possible combination effect by the results of Mace (3). The contrast reaction reported there in a disconfirmed expectancy situation also shows that the disconfirmed pleasant reaction appeared to yield a larger mean change in rating than the disconfirmed unpleasant reaction. The means reported are: disconfirmed pleasant (—22.4) and disconfirmed unpleasant (+8.6). A *t* test comparing these two means indicates a significant difference between the two ratings ($t = 1.92$, $p < .05$). In that study, the subjects were not asked to differentiate between their reaction to the stimulus and their feeling tone. It seems quite possible that a significant proportion of subjects were rating their feeling tone rather than their reaction to the stimulus.

In the study of Carlsmith and Aronson (1) there was a possible confounding variable operating. In having each subject guess whether the solution would be sweet or bitter, they attempted to increase his motivation for guessing correctly by paying him $.50 for each correct guess and charging him $1.00 for each incorrect guess. It seems possible that this factor of gain or loss of money may have influenced the perception of their subjects.

When a subject guessed wrong, he lost $1.00 and had previously been told that he could keep the amount of money that he ended up winning. If he guessed wrong, he realized it as soon as he started to taste the solution. His perception would seem to be that he had both guessed wrong on the nature of the solution and also had lost $1.00.

In viewing this possible influence, Carlsmith and Aronson state: "The difference between being correct and being incorrect with no expectancy gives an estimate of the effects of being wrong and losing money. But the crucial comparison is between being incorrect with expectancy (disconfirmation) and being incorrect without an expectancy (incorrect)" (1, p. 154).

However, this analysis does not consider a possible confounding effect. Even though their results showed significant differences between being incorrect with an expectancy and being incorrect without an expectancy, this does not eliminate the possible influence of money. The fact that they expected to win $.50 and then lost $1.00 when an expectancy was disconfirmed may have left the subjects in a psychologically negative state which affected their ratings. It seems possible that the "dissonance" reaction of these subjects was not so much with the disconfirmation of an expectancy as with the realization that they had just lost money.

E. Summary and Conclusions

To examine the effects of ego-involvement in an affective judgment situation with disconfirmed expectancies, as well as to allow *S*s to differentiate between their reactions to stimulus characteristics and personal feeling tones, both ego-involved and noninvolved *S*s had their affective expectancies disconfirmed. Using hedonic scales, the *S*s rated both their reactions to their feeling tone and stimulus characteristics when they had no expectancy and then through succeeding trials until their expectancy was disconfirmed.

The conclusions, that can be drawn from this study are: (*a*) If, in a hedonic judgment situation, individuals' expectancies are disconfirmed, they will experience a contrast effect based on the stimulus characteristics. (*b*) The magnitude of this contrast effect will be significantly stronger if they are ego-involved in the situation. (*c*) If they are ego-involved in the situation, they will also experience a strong contrast effect based on their personal feeling tone. However, if they are relatively noninvolved, there will be no significant change in their feeling tone with a disconfirmed expectancy. (*d*) Cognitive dissonance does not seem to be a major factor in their reactions in this situation. There is some evidence for a small dissonance effect in the feeling tone reactions of individuals who are ego-involved in the situation.

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THE RELATIONSHIP OF FIGURAL AFTER-EFFECTS AND GEOMETRICAL ILLUSIONS TO SUCCESSIVE AND SIMULTANEOUS CONTRASTS*

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A. INTRODUCTION

It has already been experimentally shown (1) that geometrical illusions can be decreased and even canceled by figural after-effects. These effects were respectively explained theoretically as involving the perceptual fixation of one stimulus-pattern distorting the perception of another stimulus-pattern or of the fixation of a part of a stimulus-pattern distorting the perception of other parts of the same stimulus-pattern. Fixation is induced differently in the two cases. In figural after-effects one stimulus called the inspection figure is deliberately fixated for some length of time which produces effects that are carried over or transferred to another stimulus perceived afterwards causing this latter stimulus to appear distorted. In geometrical illusions the intensity of one part of a pattern tends to draw fixation to it and this excessive fixation of one part causes other parts of the pattern to become distorted.

It is now possible to carry this experiment and theory a step further. The present author will begin by asserting that simultaneous contrasts and successive contrast are analogous or parallel to geometrical illusions and figural after-effects, respectively. What happens to the length and curvature of lines, to the size and shape of areas, and to the spatial distances between lines and areas in geometrical illusions and in figural after-effects happens analogously with chromatic and achromatic color of stimulus-patterns in simultaneous and successive contrasts. These four types of visual perceptual effects can be diagrammed in a 2 × 2 classification. There is a successive temporal effect in figural after-effects and in successive contrasts. In the former, as Gibson (2) found, a straight line may appear to curve in the opposite direction from the curvature of a previously fixated line. In the latter case, a gray color may appear bluish because the opposite color of yellow was previously fixated. And, just as Gibson found that fixating a curved line makes it appear less curved, so fixating a blue spot makes it appear less blue because it begins to get canceled

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by a yellow negative after-image that becomes superimposed over it which tends to "float away" whenever the person's fixation momentarily shifts away from the blue spot. On the other hand, there is a simultaneous temporal effect in geometrical illusions and in simultaneous contrasts. In both cases the displacing or distorting effects—in geometry or in color—are produced by one part of the pattern to another part of the same pattern that is simultaneously present. And, just as Judd (3) found that continually fixating an illusion gradually decreases it, so do simultaneous contrasts tend to become weakened when continually fixated. The type of effect in figural after-effects and geometrical illusions is geometric, and the type of effect in successive and simultaneous contrast is chromatic.

These results suggest further study. Part one of the present experiment was an attempt to produce a successive contrast effect in a test figure after fixating a successive contrast inspection figure. Part two required fixation of the same successive contrast inspection figure and attempted to decrease the simultaneous contrast effect in the Wertheimer-Benussi figure (4). The purpose of part one of this experiment was to obtain successive contrast results analogous to Gibson's figural after-effects—i.e., where fixating a curved line causes a straight line to appear curved in the opposite manner.

Since figural after-effects have been shown (1) to decrease and even cancel geometrical illusions, the purpose of part two of this experiment was to test the hypothesis that the simultaneous contrast appearing in the Wertheimer-Benussi figure (a gray ring divided in half in which the right and left halves take on some of the complementary chromatic or achromatic coloring of the colors on the corresponding sides of the background) can be canceled by successive contrast effects (produced by fixating a square that is divided into right and left halves with the same complementary colors as on the background of the Wertheimer-Benussi figure but on the reversed sides).

B. METHOD

1. *Subjects*

There were 24 subjects, male and female college students between the ages 20 and 35.

2. *Apparatus*

In part one of this experiment, on successive contrast, the test figure was a gray ring drawn on a black background. A vertical line divided both the ring and the background in half. The whole figure was on a 3-inch square card. The radius of the outer circular edge of the ring was 1-3/8 inches and the ring was

3/8 inch wide. Three different kinds of successive contrast inspection figures were used. One inspection figure was a 3- by 3-inch square card which was divided vertically in half and the right half was red and the left was green. This was to produce successive contrast making the right and left halves of the gray ring appear greenish and reddish, respectively. The other two successive contrast inspection figures that were used had a yellow right half and a blue left half, and a white right half and a black left half.

For part two, the experiment on simultaneous contrast, the Wertheimer-Benussi figure was used as the simultaneous contrast figure. The gray ring in the Wertheimer-Benussi figure was 3/8 inch wide and its outer circular edge had a 1-3/8-inches radius. The ring was divided vertically into two halves by a line to enhance the simultaneous contrast effect. Three Wertheimer-Benussi figures were used, each having a differently colored background divided into right and left halves. The right and left halves of the background of the first figure was green and red, of the second blue and yellow, and of the third black and white. These Wertheimer-Benussi figures with their simultaneous contrasts were used as the test figures. The successive contrast inspection figures fixated to produce the decrease or cancellation of the simultaneous contrasts were 3- by 3-inch squares divided vertically into right and left halves. The three successive contrast inspection figures used had correspondingly the same complementary colors as the Wertheimer-Benussi figures except that the colors were on the reverse side. Thus, when blue was on the right half side and yellow on the left half side of the background of the Wertheimer-Benussi figure, the successive contrast inspection figure consisted of a square in which the right half side was yellow and the left half side was blue. The inspection figures for the other two Wertheimer-Benussi figures were correspondingly reversely colored. These inspection figures were the same as the successive contrast inspection figures that were used in part one of this experiment, as can be seen in Figure 1.

The three simultaneous contrast Wertheimer-Benussi figures, the three successive contrast inspection figures, and the one successive contrast test figure which was a gray ring divided in half on a black background divided vertically in half were drawn in black India ink on white cardboard. The figures were painted with water colors. The red, yellow, green, and blue colors approximated the spectral colors with wavelengths of 650, 575, 525, and 450 mμ.

3. *Procedure*

In part one, the successive contrast experiment, each of the three successive contrast inspection figures was used with eight of the 24 subjects. After initially

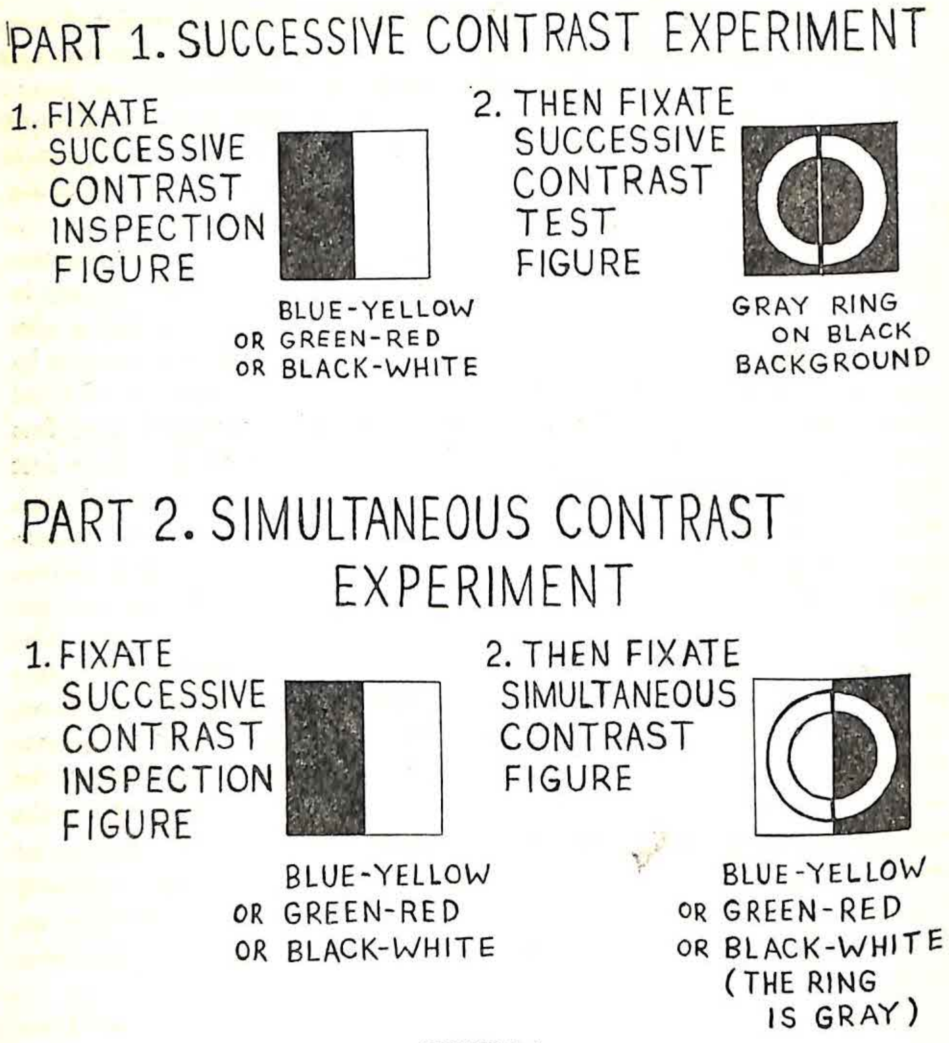
PART 1. SUCCESSIVE CONTRAST EXPERIMENT
1. FIXATE SUCCESSIVE CONTRAST INSPECTION FIGURE
BLUE-YELLOW OR GREEN-RED OR BLACK-WHITE
2. THEN FIXATE SUCCESSIVE CONTRAST TEST FIGURE
GRAY RING ON BLACK BACKGROUND
PART 2. SIMULTANEOUS CONTRAST EXPERIMENT
1. FIXATE SUCCESSIVE CONTRAST INSPECTION FIGURE
BLUE-YELLOW OR GREEN-RED OR BLACK-WHITE
2. THEN FIXATE SIMULTANEOUS CONTRAST FIGURE
BLUE-YELLOW OR GREEN-RED OR BLACK-WHITE (THE RING IS GRAY)

FIGURE 1
THE FIGURES USED TO PRODUCE SUCCESSIVE AND SIMULTANEOUS CONTRAST EFFECTS

viewing the successive contrast test figure (the gray ring on a black background divided vertically in half), a subject fixated one of the three successive contrast inspection figures (such as a square card divided vertically into a red right half and a green left half) for four different amounts of time as follows: A, five seconds; B, 30 seconds; C, 60 seconds; and D, 120 seconds. Fixation was up and down the vertical center line. After fixating a successive contrast inspection figure for one of these lengths of time, he was shown immediately the gray ring on black background to fixate up and down on its center vertical line and asked to name the colors appearing in the two sides of the gray ring. The amount of time that he saw colors in the two sides of the gray ring was recorded in seconds with an Ingraham Sebring 500 stop watch.

There were five-minute intervals between each of the trials a subject had with the four amounts of time that he fixated a successive contrast inspection figure. Two of eight subjects fixated a successive contrast inspection figure for the four amounts of time in the order ABCD, two in the order DABC, two in the order CDAB, and two in the order BCDA. This entire procedure was repeated with the other two groups of eight subjects, each group fixating one of the other two successive contrast inspection figures for the four amounts of time—A, B, C, and D—and then viewing the gray ring on the black background.

In part two, the simultaneous contrast experiment, each of the three Wertheimer-Benussi simultaneous contrast figures was used with eight of the 24 subjects. A subject had the same colored successive contrast inspection figure for both parts of the experiment. After initially viewing one of the Wertheimer-Benussi figures, a subject fixated the appropriately colored successive contrast inspection figure for four different amounts of time as follows: A, five seconds; B, 30 seconds; C, 60 seconds; and D, 120 seconds. Fixation was up and down the center vertical line. After fixating a successive contrast inspection figure for one of these lengths of time, he was immediately shown the appropriate Wertheimer-Benussi simultaneous contrast figure to fixate up and down at its center vertical line and asked to name the colors appearing in the two sides of its gray ring. The amount of time that he saw the simultaneous contrast effect in the Wertheimer-Benussi ring overcome—reversed, equalized, or decreased—was recorded in seconds with an Ingraham Sebring 500 stop watch. Here also there were five-minute intervals between each of the trials with the four amounts of time that a successive contrast inspection figure was fixated. Two of eight subjects fixated a successive contrast inspection figure for the four amounts of time in the order ABCD, two in the order DABC, two in the order CDAB, and two in the order BCDA.

This entire procedure was repeated with the other two groups of eight subjects, each group fixating one of the other two successive contrast inspection figures for the four amounts of time—A, B, C, and D—and then viewing the appropriately colored Wertheimer-Benussi figure as the simultaneous contrast figure.

The use of Wertheimer-Benussi figures with three different complementary pairs of colors was to balance the design; the use of complementary colors was to make all contrast color effects appear more clearly and unambiguously.

The same 24 subjects were used in the successive contrast part of the experiment and in the simultaneous contrast part of the experiment, but 15 minutes separated the two parts of the experiment and every odd numbered subject had the simultaneous contrast part of the experiment first and every even numbered subject had the successive contrast part of the experiment first. As already mentioned, each subject had the same pair of complementary colors in both parts of the experiment and exactly the same successive contrast inspection figure for both parts of the experiment.

Altogether, for each of the two parts of this experiment, there were six subjects for each order of presentation of the four amounts of time that the successive contrast inspection figures were fixated (two for each of the complementary color pairs), and there were four orthogonal orders of presentation (ABCD, DABC, CDAB, and BCDA). A Latin square design analysis of variance was done with the data of the first part of the experiment on successive contrast and another Latin square analysis of variance was done with the data of the second part of the experiment on simultaneous contrast. Comparisons were also made between the results of the two experiments by appropriate t tests.

C. RESULTS

The first part of this experiment shows that it was possible to produce a successive contrast effect in a test figure by an inspection figure. The colors produced in the two sides of the gray ring in the test figure were the reverse or negative after-images of the colors in the successive contrast inspection figure. Thus, when the inspection figure was blue on the left half side and yellow on the right half side, the gray ring in the test figure appeared yellowish in the left side and bluish in the right side. When the inspection figure was green on the left side and red on the right side, the gray ring in the test figure appeared red in the left side and greenish in the right side. And when the inspection figure was black on the left side and white on the right side, the gray ring in the test figure appeared whitish on the left side and tended to appear more black on the right side.

The means of the amount of time that the successive contrast effects were seen were 5.25 seconds when the inspection figure was fixated for five seconds, 23.38 seconds when the inspection figure was fixated for 30 seconds, 31.98 seconds when the inspection figure was fixated for 60 seconds, and 41.36 seconds when the inspection figure was fixated for 120 seconds.

A Latin square analysis of variance done with this data shows that this successive contrast effect on the test figure became greater as the inspection figure was fixated longer. The F for fixation time of inspection figure was 269.28 which is significant at better than the one percent level.

In the second part of this experiment, the subjects typically saw the simultaneous contrast effect in the Wertheimer-Benussi figure overcome and reversed, then equalized (when both sides of the gray ring appeared the same), and then gradually saw the full effect of the simultaneous contrast effect return. The means of the amount of time that the simultaneous contrast effects were decreased were 1.83 seconds when the inspection figure was fixated for five seconds, 16.42 seconds when the inspection figure was fixated for 30 seconds, 25.80 seconds when the inspection figure was fixated for 60 seconds, and 35.44 seconds when the inspection figure was fixated for 120 seconds.

The Latin square analysis of variance done with this data shows that the length of time that the decrease or cancellation of the simultaneous contrast effect lasts depends on the amount of time that the successive contrast inspection figure was fixated. The *F* for fixation time of inspection figure was 163.92 which is significant at better than the one percent level. Subjective descriptions also indicate that when the successive contrast inspection figure was fixated for one to two minutes there was more reversal of the simultaneous contrast effect (which is the complete dominance of the negative after-imagery from the successive contrast inspection figure), whereas when the fixation time was only one-half minute there tended to be just a decrease in the simultaneous contrast effect. At five seconds fixation time the decrease of the simultaneous contrast was very small and many subjects did not see the effect at all.

When the test figure was a simultaneous contrast Wertheimer-Benussi figure with a background that is blue on the right half side and yellow on the left half side, the gray ring appeared yellowish on the right side and bluish on the left side. It was found that when the successive contrast inspection figure with a blue left half side and a yellow right half side is fixated first, the negative after-imagery produced tends to cancel or decrease the simultaneous contrast effect in the test figure. Parallel results were obtained when the colors used were green and red, or black and white.

Since the same successive contrast inspection figures were used to produce successive contrast in the successive contrast test figures and to decrease or cancel the simultaneous contrast effects in the simultaneous contrast figures that were used as test figures, and since both kinds of test figures contain the same kind of gray ring, we can do meaningful *t* tests comparing the amount of time that the successive contrast inspection figures produced successive contrast effects and the amount of time that the successive contrast inspection figures overcame simultaneous contrast effects. The *t* values for the differences between these means are as follows: for five seconds fixation time of the successive contrast inspection figures, $t = 5.49$; for 30 seconds fixation time, $t = 3.97$; for 60 seconds fixation time, $t = 3.41$; and for 120 seconds fixation time, $t = 2.42$.

These *t*'s are all significant at the five percent level, and all but the last value of *t* are significant at the one percent level. It was expected that the successive contrast effects produced by the successive contrast inspection figures are seen longer by themselves on the successive contrast test figure than they are seen when they are superimposed on a simultaneous contrast figure which they decrease or cancel.

The results confirm the hypothesis that successive contrast effects can decrease or overcome simultaneous contrast effects.

D. Discussion

The results show that successive contrast effects can decrease simultaneous contrast effects. This finding is analogous to the results of a previous experiment (1) that figural after-effects can decrease and even cancel geometrical illusions, which was explained by a unified theory. It is now possible to explain all four phenomena as different aspects of one hypothesized process. That is, it may be hypothesized that when a stimulus is visually perceived, the visual and central nervous system produces negative after-effects (after-images) which both reverse the stimulus geometrically (structurally) and reverse it chromatically. This is supported by Gibson's (2) finding that continued perception of a curved line tends to make it appear more straight (it tries to curve the other way and so becomes straighter) and in the finding that continued perception of a color causes a negative after-image. This process is probably to help erase the effects of stimulation in the sensory (input) system so that the sensory system becomes fully ready to receive new stimulation. However that may be, we can hypothesize that attention tends to be drawn toward the more intense parts of a stimulus-pattern, thereby further increasing the intensity of these parts. In this way the author has already explained geometrical illusions and figural after-effects.

Geometrical illusion figures have parts that are more intense—because the lines are longer or closer together there—and so more neurons that are close together are stimulated in the visual cortex corresponding to this part of the figure than for other parts of the figure. In the Hering illusion, for example, the intense part of the figure (where many radiating lines all come to one point) is between two lines. It was hypothesized (1) that many neural impulses of the attention process are directed to the intense part of the figure, making it still more intense, and therefore fewer neural impulses of the attention process are available for other nearby areas, so the middle parts of the two straight lines (which are closest to the intense point) bend away from this point in order to be able to obtain more neural impulses of the attention process.

The neural impulses of the attention process are from the ascending reticular formation system (5). The lower parts of the reticular formation produce wakefulness and the upper parts that make contact with the cortex produce attention. Attention to external (e.g., visual) stimuli is also produced by directing sensory organs (e.g., the eyes) toward stimuli, and this also causes increased neural impulses in the visual cortex from input of the parts of stimulus-patterns that are attended.

Figural after-effects can be explained by the same processes as geometrical illusions, but they are *induced* differently. In the original figure used by Gibson (2), the curved line fixated first is more intense than the background, and its intensity is increased by the *duration* of fixation of it because the neural impulses of the attention process continue to be directed to it. This intense area involves many neural impulses that were started where the curved line was represented and so persists for a time after the curved line is removed from sight, and insofar as these neural impulses persist they still make contact with neural impulses of the attention process and less attention is available for nearby areas. Therefore, to obtain attention the upper, middle, and lower parts of the straight line presented afterwards over this curved area bend away from the upper, middle, and lower parts of this curved area making the line appear as an opposite curve. As the author previously explained (1, p. 72):

> In illusions the *size and closeness of lines* cause some parts to be more intense, and in after-effect figures *duration* of inspection makes them more intense. Duration of inspection also makes the intensity persist partially so that an after-effect can occur afterward with the test figure when the original after-effect figure has been removed, *whereas in the case of illusions the parts that are minimized or decreased are already in the illusion figure.*
>
> *Since the processes of illusions and after-effects are the same they can cancel each other.* The intensity of the original after-effect figure is increased by the duration of inspection and, instead of the parts of the test figure being decreased in certain ways, it decreases the intense parts of the illusion figures . . . enough so that the intensity of these parts is not greater than for other parts of the illusion figure, and the illusion effect disappears.

The main difference between figural after-effects and geometrical illusions on the one hand, and successive contrasts and simultaneous contrasts on the other hand, is that in the latter the gestalts are better (more coherence, stronger boundaries, greater continuity) so that the perceived parts of the figure cannot move and so have to change in color. In figural after-effects and geometrical illusions the figures are gestalts with less coherence, weaker boundaries, poorer continuation, and so parts of the figures can move more easily—changing position, curvature, size, shape, length, and other geometrical characteristics—and therefore colors do not have to change. It is because these figures are weaker gestalts that their parts move more easily and the moved parts then escape the color change effects produced by fixation of the intense or dominant parts. The hypothesis is that insofar as the position of parts of a stimulus-pattern cannot change, the colors of the parts must change.

In the case of successive contrast effects the figures have much stronger boundaries and are therefore stronger figures. Attention tends to be drawn therefore more equally to different parts of the figure. If the parts are differently colored, attention to the different parts intensifies the specific colors perceived in these parts. This causes negative after-effects (or negative after-images) that eventually tend to decrease or attenuate the colors of the stimulus-pattern. It is hypothesized that what is perceived depends on the neural processes in the visual areas of the brain. It is there that the impulses coming from the retina, representing the visual stimulus, are initially made more intense by the ascending reticular formation impulses of the attention process; and then the continued intensity of the attention process causes some negative after-effect in the visual areas that attenuates the colors perceived in the stimulus-pattern. If the stimulus is removed, the input from the retina continues for a while in a reduced manner which the attention process can completely reverse in the visual areas into negative after-imagery.

If the stimulus-pattern is then replaced by another stimulus-pattern of different colors, the negative after-imagery of the previous stimulus gets superimposed on the colors of the new stimulus-pattern and successive contrast occurs. This is most clearly and uncomplicatedly seen when the second (test) stimulus-pattern is gray as was the case in the first part of this experiment. Successive contrasts are induced by successive fixation just as figural after-effects are.

If the second (test) stimulus would be the same as the first (inspection) stimulus in its colors and position of colors, it would be as if the first stimulus had been continued longer and the successive contrast effect then would result in a slight decrease in the strength of the colors. And, if the first stimulus would be a square divided into a yellow right half and a blue left half, a *red* ring subsequently would appear purple in the right side and orange in the left side. All kinds of conmplicated successive contrast effects occur.

Just as geometrical illusions simultaneously contain both the part or parts that cause geometrical distortions and the equal parts that are differentially distorted by the negative after-effects from the geometry of the distorting parts, so do simultaneous contrast figures contain both the part or parts that cause color distortions and the equal parts that are differentially distorted in color by the negative after-imagery from the colors of the distorting parts. Simultaneous contrast, like geometrical illusions, are induced simultaneously with one part of the figure influencing the perceptual appearance of other parts. Attention gets directed excessively to the intense parts, which thereby become the distorting parts, in both geometrical illusions and in simultaneous contrast figures. The objectively equal parts thereby become distorted and appear unequal in geometry or in color. The essential difference between geometrical illusions and simultaneous contrast figures (like the Wertheimer-Benussi figure) is that in geometrical illusions the intense part or parts that get more of the attention are only a part of the figure that is left after excluding the equal parts that get distorted, while in simultaneous contrast figures the intense or dominant parts that get more of the attention are all of the figure that is left after excluding the equal parts that get distorted.

Because in simultaneous contrast figures the intense or dominant parts that receive more attention are the whole figure except for the equal parts, we can also state that the geometry of a simultaneous contrast figure is a strong and coherent gestalt that does not allow for movement of parts as occurs in geometrical illusions and therefore color contrast changes occur instead.

Finally, just as the author (1) previously found that geometrical illusions can be decreased or canceled by figural after-effects, so it was found in the second part of this experiment that simultaneous contrast effects can be decreased or canceled by successive contrast effects. This can be explained as follows. When the second (test) stimulus is a simultaneous contrast figure, such as a Wertheimer-Benussi figure, with background colors (such as blue and yellow) that are on the reverse side from the position of these colors on the first (inspection) figure, the negative after-imagery or successive contrast effect from the first figure becomes superimposed on the simultaneous contrast figure and cancels or overcomes its simultaneous contrast effect.

E. SUMMARY

This was an experimental study consisting of two parts. In the first part a successive contrast effect was produced and in the second part the same successive contrast inspection figure that produced the successive contrast effect was used to decrease or cancel a simultaneous contrast effect. This finding was taken to be analogous to the author's previous experimental results which showed that figural after-effects can be used to decrease or cancel geometrical

illusions. Since it was noted that the same basic process is involved in all these phenomena, a unified theory was presented to explain figural after-effects, geometrical illusions, successive contrasts, and simultaneous contrasts.

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By Russell Eisenman

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By ANTHONY D. MULLOZZI, JR.

Children's self-concept and kindergarten achievement 185
By RICHARD J. OZEHOSKY AND EDWARD T. CLARK

Conceptual frames of parental attitudes of fathers 193
By SHIRIN SCHLUDERMANN AND EDUARD SCHLUDERMANN

Conceptualization of maternal behavior 205
By SHIRIN SCHLUDERMANN AND EDUARD SCHLUDERMANN

Community differences in positive mental health of younger workers . . . 217
By H. MELTZER AND D. LUDWIG

Periflash 225
By FRANK M. DU MAS

Culture and strategic choice 227
By ROGER SHERMAN

The relative importance of selected behavioral characteristics of group members in an extreme environment 231
By RICHARD E. DOLL AND E. K. ERIC GUNDERSON

Nonverbal rigidity and perseveration 239
By STEPHEN BRESKIN, BERNARD S. GORMAN, AND SIDNEY H. HOCHMAN

Comparison between Americans living in Israel and those who returned to America: Part II, Israeli background 243
By GERALD ENGEL

Student political activity in relation to personal and social adjustment . . . 253
By DONALD KIRTLEY AND RICHARD HARKLESS

Stimulus generalization following multidimensional stimulus training *vs.* unidimensional stimulus training 257
By RONALD P. GRUBER

Discrimination, generalization, and awareness in verbal operant conditioning 263
By RONALD P. GRUBER

Effects of Lysergic Acid Diethylamide on the maternal behavior of the rat . 271
By EDWARD T. UYENO

NEWS NOTE 275

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EFFECTS OF STIMULUS DURATION AND REINFORCEMENT SCHEDULES ON SELF-REINFORCEMENT*[1]

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A. Introduction

The process by which one regulates his own behavior has recently begun to attract the interest of various investigators. The concept of self-reinforcement (SR) has been used to account for the regulation of behavior by the individual himself. That is, the individual administers consequences to his own behavior. The improvement of human performance in the absence of externally controlled feedback has also been noted in the literature on perception (1).

Previous investigations (2, 3, 6) have made use of a paradigm in which an adult *S* was free to administer positive generalized reinforcers, such as tokens, contingent upon the *S*'s evaluation of the adequacy of his responses. The results of these investigations parallel the effects typically produced when the reinforcement is delivered by another agent, such as the experimenter. Thus far, the results of the self-reinforcement studies have demonstrated that self-regulatory behaviors can be accommodated within a reinforcement-based theory of social learning.

The purpose of the present investigation was to study some of the additional variables that may be related to the development and maintenance of self-regulatory behaviors. The focus in this study was on some of the motivational and perceptual events which contribute to individual differences in the rate of self-reinforcement. There is undoubtedly a complex array of variables that interact to produce the maintenance of a behavior for which there is no direct reinforcement. Although SR can be considered one of the maintaining variables, the reinforcement practices of the verbal community, as well as the particular context in which the behavior is emitted, may affect both the rate of SR and the rate of the observed behavior. The specific purpose of this study was to determine the effect of different histories of direct reinforcement schedules on the rate of SR. A second and related purpose was to determine to what extent

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a characteristic of the environment, such as "perceptual clarity," affected the rate of self-reinforcement. Perceptual clarity was operationally defined as the duration of stimulus exposure in a perception task.

B. METHOD

1. *Subjects*

A total of 160 volunteer subjects drawn from the introductory psychology course at the University of Missouri—Kansas City participated in the experiment. There were 10 *S*s randomly assigned to each of the 16 treatment cells of a 4 × 4 factorial design.

2. *Apparatus*

A Lafayette Model #KT800 Kodak Carousel Tachistoscope was used to present the visual stimuli. A series of 50 35-mm slides were prepared. Each slide had a cross-grid section containing 16 squares. There were black dots enclosed within some of the squares. The number of dots on each slide varied from four to 16. The subject's task was to report the number of dots. The series of 50 slides was presented four times to each *S*.

The slides were projected on a screen in front of the subject. On the *S*'s desk was a light and a point counter. Reinforcement consisted of a light flash and the registration of the point on the counter. Since the *S* sat in a completely darkened room he could not see the points on the counter until the end of each experimental phase. However, the combination of the light flash and the distinctly audible click of the counter was sufficient to inform the *S* when he had earned a point. The circuit was arranged so that either *E,* who was located in an adjacent control room, could control the delivery of points or *S* could depress a button switch at his desk.

3. *Procedure*

The variables investigated in this experiment were duration of the stimulus and reinforcement schedules. Each *S* was assigned to a combination of one of the four stimuli and one of the four reinforcement schedule groups. The stimulus exposure groups were (*a*) five seconds, (*b*) .10 second, (*c*) .01 second, and (*d*) .01-second blur. The five-second and blur groups represented extremes on a perceptual clarity continuum. An exposure speed of five seconds was slow enough for the *S* to give an accurate report of the number of dots. In the last exposure duration, the image was presented out of focus, thus creating a condition which made it difficult to perceive accurately the number of dots. It was thought that under this condition the effects of sensory determinants would be minimized so that differences in the effects of reinforcement schedules might be more apparent.

There were two phases in the experimental session. During the first phase the *S*s were given direct reinforcement by *E* according to one of the four reinforcement schedule groups to which they had been assigned. In the second phase of the experiment, direct reinforcement was discontinued and the *S*s were permitted to deliver their own reinforcement. This phase was known as the self-reinforcement phase. Each phase of the experiment was made up of 100 slide presentations.

The four direct reinforcement schedules were (*a*) continuous reinforcement (CRF), (*b*) fixed ratio reinforcement (FR), (*c*) variable ratio reinforcement (VR), and (*d*) no reinforcement (control). In the CRF group points were delivered on every response. The FR group received a point after each third response (FR:3), and the VR group received on the average of one point for every three responses (VR:3). The numbers of points delivered to the FR and VR groups were identical. There were only differences in the schedule of the point delivery. The control group did not receive any points during the first phase of the experiment.

The *S*s were led into the experimental room and told that they were about to participate in an experiment in visual discrimination. They were told that slides with different numbers of dots would be flashed on the screen in front of them. They were requested to report the number of dots on each slide and to guess or give an estimate even if they were not sure. The *S*s were then given a few practice slides at a five-second duration exposure. The *S*s in the three experimental groups (CRF, FR, and VR) were told that points would register on their counter, but they were to keep their eyes on the screen at all times. They would know when they were receiving a point by the light flash and counter click. The *S*s were not informed of the basis on which they received points.

The first half of the session was the direct reinforcement phase. The *S* received points and was presented the slides at the exposure duration according to the treatment group to which he was assigned. Each of the 50 slides was presented twice during this phase. There was an intertrial interval of eight seconds. The points were made contingent only on the *S*'s response of reporting the number of dots. The reinforcement was *not* contingent on the accuracy of the report.

The second half of the session was designated as the self-reinforcement phase. Prior to the beginning of this phase *E* recorded the number of points that were on the *S*'s counter and also informed the subject how many points he had accumulated during the previous phase. He then handed the *S* a button switch and told him that from now on he was delivering his own points. The *S* was told to press his button each time he thought his response was appropriate. Although some *S*s asked what was meant by "appropriate," they were given the noncommittal reply, "That's up to you." During the self-reinforcement phase the slides were again presented for 100 trials. The *E* kept a record of the *S*'s responses and whether or not the *S* reinforced himself.

C. RESULTS

1. *Self-reinforcement*

An analysis of variance was made of SRs for the various treatment groups. The results of this analysis indicated there were significant differences between reinforcement schedules ($F = 24.94$, $p < .01$ for 3/144 *df*) and exposure durations ($F = 21.23$, $p < .01$ for 3/144 *df*).

A Duncan Multiple Range Test was used to locate the source of these differences. The results of the Duncan analysis appear in Table 1. The mean number of SRs for each reinforcement schedule group is presented in Figure 1. The results indicate a deceleration of SR as tachistoscopic-exposure speed increased. However, there was only a statistically significant duration effect between the five-second duration level and the remaining duration speeds.

TABLE 1
DUNCAN MULTIPLE RANGE TEST OF DIFFERENCES IN FREQUENCY OF SELF-REINFORCEMENT[a]

	Reinforcement Schedules			
Treatment Group:	CRF	Control	FR	VR
Mean:	79.60	58.57	52.57	44.50
	Exposure Durations			
Treatment Group:	5 Sec.	.10 Sec.	.01 Sec.	.01 Sec. Blur
Mean:	78.72	58.15	49.75	48.57

[a] Any two means not underscored by the same line are significant at the .01 level of confidence.

The main effects for reinforcement schedules show the CRF group produced a significantly higher rate of SR than all other groups. The control group produced the next highest frequency of SR and was significantly different from the VR but not the FR group. Although the differences between FR and VR were not significant at the .01 level, it should be noted that the differences barely missed significance and would be considered significant if alpha were equal to .05. The results clearly indicated that the reinforcement schedules used

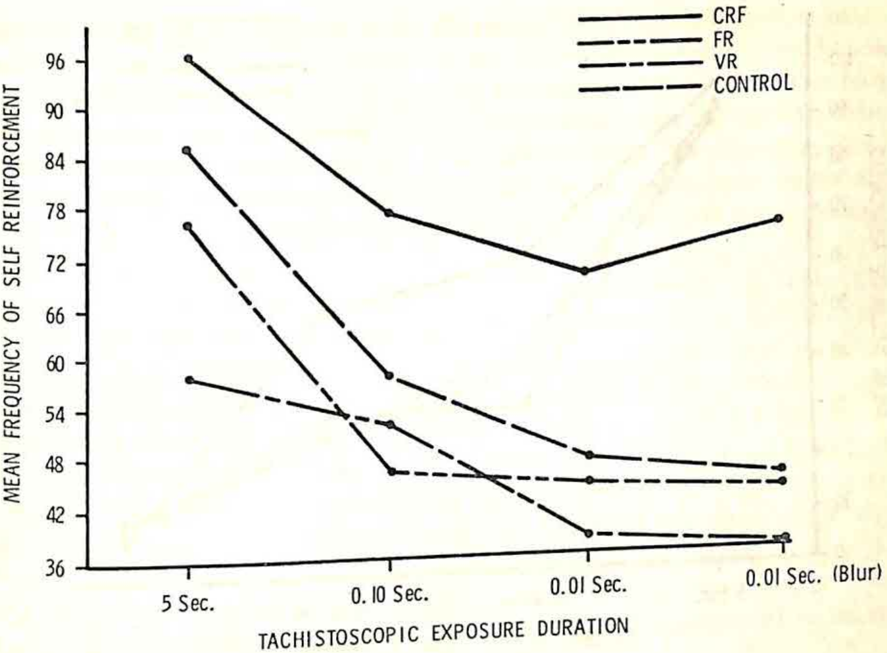

FIGURE 1
MEAN FREQUENCY OF SELF-REINFORCEMENTS FOR REINFORCEMENT SCHEDULE AND STIMULUS DURATION TREATMENT GROUPS

during the direct reinforcement phase exerted different effects on the frequencies of SR.

2. *Accuracy*

An analysis of variance of repeated measures was performed to determine if there were any differences between treatment groups in terms of the response accuracy. According to this analysis there was significant schedules effect ($F = 13.15$, $p < .01$ for 3/104 *df*), a significant durations effect ($F = 335.00$, $p < .01$ for 3/104 *df*), and a significant schedules by duration interaction ($F = 3.28$, $p < .01$ for 9/104 *df*). A Duncan analysis for these main effects is presented in Table 2. This analysis shows that the control group's accuracy level was significantly greater than all other groups and that there were no significant differences between the experimental groups. The analysis of the duration main effect revealed significant differences between all duration exposure speeds. As exposure speed was increased, the number of accurate responses decreased.

The mean number of accurate responses is also presented in Figure 2. The

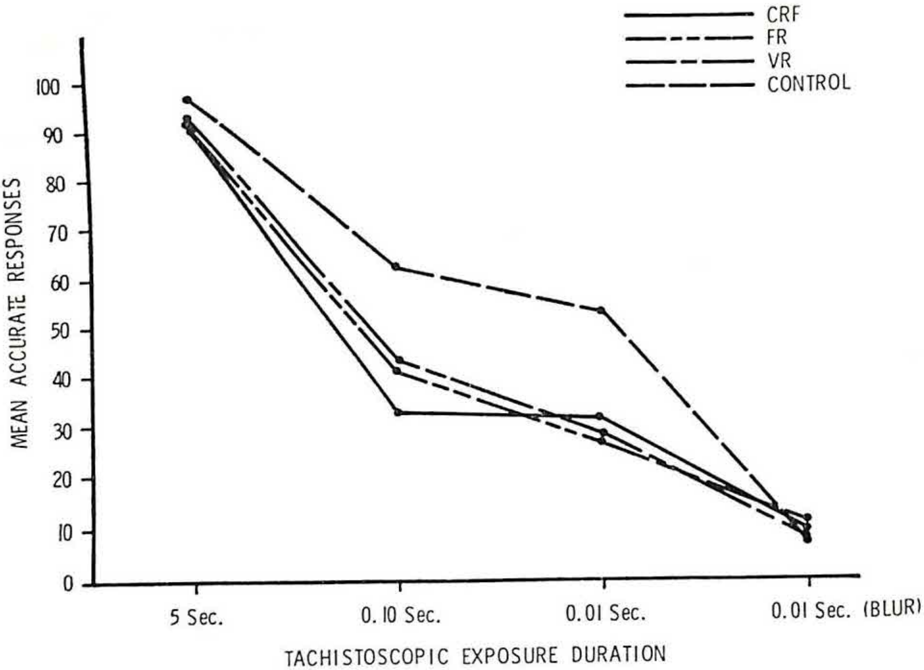

FIGURE 2
MEAN FREQUENCY OF ACCURATE RESPONSE FOR REINFORCEMENT SCHEDULE AND STIMULUS DURATION TREATMENT GROUPS

reason for the significant interaction is that the control group had a larger mean number accurate responses at the .10-second and .01-second-exposure durations than did the experimental groups. The authors can offer no plausible interpretation of this result.

There was also apparently some practice effect as indicated by a significant within-phase effect ($F = 2.74$, $p < .05$ for 3/184 *df*). During direct reinforcement the mean number of accurate responses was 43.3, and during the

TABLE 2
DUNCAN MULTIPLE RANGE TEST OF DIFFERENCES IN ACCURACY OF SELF-REINFORCEMENT

	Reinforcement Schedules			
Treatment Group:	CRF	FR	VR	Control
Mean:	41.30	42.52	42.50	55.88
	Exposure Durations[b]			
Treatment Group:	.01 Sec. Blur	.01 Sec.	.10 Sec.	5 Sec.
Mean:	9.57	35.21	44.72	92.70

[b] Differences between all duration means are significant at the .01 level.

self-reinforcement phase it was 47.8. However, the phase by duration interaction indicated that the practice effect was dependent on the exposure-speed level. An additional analysis revealed that the magnitude of the practice effect was larger at the slower exposure speeds (five seconds and .10 second) than at the more rapid speeds (.01 second and .01- second blur). On the other hand, the phase by reinforcement schedule interaction was not significant, suggesting that the different reinforcement schedules did not exert differences in the amount of practice effect.

An analysis was also made on the accuracy of self-reinforcement. Although there were considerable differences in the mean number of self-administered reinforcements during the five-second duration and the .01-second blur duration (see Figure 1), there are only negligible differences in the proportions of accurate responses. During the .10-second duration, the number of self-reinforcements delivered by the CRF group was much higher than any of the other groups, but the proportion of these responses that were accurate was considerably lower than the other groups. During the .10-second and .01-second durations the control group had a higher proportion of accurate responses than any of the experimental groups. It is also quite evident that except for the control group, at the .10-second and .01-second durations the proportion of accurate SRs decreased as a function of increased exposure speed.

D. DISCUSSION

The results of this investigation suggest that different histories of reinforcement scheduling do affect the subsequent frequency of self-administered reinforcement. Subjects who had a continuous reinforcement history reinforced themselves more frequently than any other group. Although not statistically significant, there were also differences between the two intermittent reinforcement schedules. The *S*s who had a history of fixed ratio reinforcement tended to reinforce themselves more often than *S*s who had a history of variable ratio reinforcement. These results are consistent with those obtained in previous investigations. Although using a different type of testing situation but one which also involved an ambiguous task, Kanfer and Duerfeldt (3, 4) found that the rate of direct or external reinforcement affected the subsequent rate of SR. Our finding that the intermittent schedules produced lower amounts of SR than a continuous schedule is also consistent with the schedule effects produced in the related area of vicarious reinforcement. For example, Marston and Kanfer (7) found that decreasing the proportion of reinforced vicarious responses resulted in significantly lower learning.

The probability of self-reinforcement is higher under conditions of long exposure than under short-exposure speeds. This effect appears regardless of the reinforcement schedule history. However, at each duration level the relative order of the various reinforcement schedule groups is maintained.

The analysis of the accuracy data revealed significant differences at all exposure-duration speeds. Thus, as the exposure time decreased there was a deceleration in the amount of accuracy. The fact that significant differences in frequency of SR were not found at all exposure durations but that there were significant differences in accuracy at all exposure durations would suggest that accuracy may be under the control of perceptual or sensory variables, whereas self-reinforcement behaviors may be more predominantly under the control of motivational and learning variables.

The results of the CRF and control groups are of particular interest. Both of these groups had relatively high rates of self-reinforcement. However, the accuracy of the control group, particularly at the .10- and .01-exposure durations was substantially higher than the CRF group. The superior accuracy of the control groups at the .10 second and .01-second exposures was not anticipated. Thus any interpretations of these results are quite tentative and depend on the reliability of this effect. On the basis of the present data, however, it would appear that the visual or sensory characteristics exerted less control over the experimental groups than the control group.

There were also rather substantial differences between experimental groups. The CRF group exhibited a higher frequency of self-reinforcement and a lower level of accuracy than the FR and VR groups. There may be several reasons for the differences in schedule effects. Under conditions where there is not a clear basis for making a discrimination, it might be anticipated that motivational variables would be responsible for the differences in the frequency of self-reinforcement. For example, in a study by Kanfer, Bradley, and Marston (5) in which subjects were required to learn new material, it was found that the number and the accuracy of self-reinforcing responses were higher for *S*s who had more learning trials than for *S*s who had fewer learning trials. Thus the rate of self-reinforcement was found to be a function of the strength of the learned discrimination. In a similar vein the results of the present investigation revealed that the rate of self-reinforcement tended to decrease as a function of stimulus exposure. However, even under conditions of maximal clarity (five-second duration) there were still large differences in the frequency of self-reinforcement between schedules. One reason for the differences might be that the *S*s were simply matching their direct reinforcement rates. This could account for the relatively high self-reinforcement frequency for the CRF group. However, the number of direct reinforcements *per se* does not appear to be the only variable exerting an effect, since there were also substantial differences between the VR and FR groups under the five-second-duration exposure. It is suspected that adventitious reinforcement may be responsible for some of these effects. The *S*s were not reinforced for accuracy nor were they told in the instructions that accuracy was the basis for administering points. In the absence of specific instructions regarding accuracy, *S*s on intermittent schedules may have associated the points with stimulus characteristics other than the number of dots. Although a formal postexperimental interview was not conducted, some *S*s who had been in the intermittent schedule groups made such comments as, "I couldn't find the right pattern of dots," and "What was I supposed to be looking for?" The adventitious reinforcement hypothesis could still be true despite small differences between FR and VR at the faster exposure durations, since the *S*s could not easily verify the validity of their hypotheses.

The relatively high rates of self-reinforcement by the CRF group could also be explained in terms of their direct reinforcement history in which "all responses were correct" and, hence, this group had no basis for making a differential discrimination. On the other hand, the control group did not have any feedback during the direct reinforcement phase and, hence, would have no reason to assume that reinforcement should be dispensed on any basis other than accuracy. It is also quite possible that the behavior of the CRF groups may be limited to the specific conditions of this experiment. If the experiment had been designed so that each subject was tested at all exposure durations, it is suspected that different functions may have been obtained. It is also suspected that the specific functions would depend on the particular presentation sequence of exposure duration.

It is quite apparent that the rate of self-reinforcement is under the control of a complex array of variables which include the specific reinforcement schedule, the stimulus conditions, the instructions given by the experimenter, and probably also by the instructions the subject gives himself.

E. SUMMARY

The purpose of this study was to determine the effect of reinforcement schedules and stimulus-exposure duration on the frequency and accuracy of self-reinforcement. The stimuli consisted of a grid square containing dots which varied in number and which were presented tachistoscopically. There were four exposure durations: (*a*) five seconds, (*b*) .10 second, (*c*) .01 second, and (*d*) .01-second blur. The *S*s were requested to report the number of dots on each slide. There were three reinforcement schedules investigated:

continuous reinforcement (CRF), fixed ratio (FR), and variable ratio (VR). A fourth group was a control and had no external reinforcement. The 160 *S*s were randomly assigned to a treatment condition consisting of one of the reinforcement schedules and stimulus exposure durations. Each *S* participated in two phases. During the first phase *E* administered reinforcement according to the treatment group to which the *S* was assigned. During the second phase *E* relinquished control of the reinforcement and allowed the *S* to administer his own reinforcement.

The results showed both duration and reinforcement schedule main effects. The frequency and accuracy of self-reinforcement decreased as a function of decrease in exposure duration. The *S*s who had the CRF reinforcement history had the highest frequency of self-reinforcement. There were no differences between the intermittent schedule groups (FR and VR) in the frequency of self-reinforcement. Both intermittent schedules produced lower frequency of self-reinforcement than the control group. It was also found that the control group had a higher proportion of accurate self-reinforcement responses than any of the experimental groups. These results were generally consistent with those found in other investigations.

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BIRTH ORDER, SEX, SELF-ESTEEM, AND PREJUDICE AGAINST THE PHYSICALLY DISABLED*[1]

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A. INTRODUCTION

Two studies are presented in this paper. The first is concerned with possible birth order and sex differences in self-esteem, while the second study is concerned with the relationship of birth order, sex, and self-esteem to prejudice. With regard to the demographic variables of birth order and sex, it is possible for there to be birth order and sex influences on a given variable, but for the researcher to miss this effect through inadequate data analysis. The author has found (6, 9, 15), using polygons varying in complexity-simplicity, that firstborn males often prefer complexity, while among females either there is no birth order difference or later born females prefer more complexity than firstborn females. Note that these findings are stated in terms of an interaction between birth order and sex. If one combined all male *S*s and compared them to all female *S*s one might find no sex difference. Likewise, if one combined all firstborns and compared them against all later borns, one might be led to conclude that there was no birth order effect. The fallacy in both cases is to neglect to consider the joint effects of birth order and sex, as in the phrase "firstborn males." There typically are birth order and sex differences found in the area of complexity-simplicity preferences, but the analysis of sex or birth order singly, rather than in combination would give one the erroneous impression that neither variable had any effect.

B. STUDY I

Studies by Coopersmith (4), Rosenberg (12), and Platt, Moskalski, and Eisenman (11) have all suggested that firstborn or only child *S*s may tend to have higher self-esteem than later born *S*s. The present study sought to

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investigate the joint effects of birth order and sex on self-esteem as measured by semantic differential ratings of real self and ideal self. By having *S*s respond to these two concepts one obtains a discrepancy score, and high self-esteem is operationally defined as a low discrepancy between real self and ideal self.

1. *Method*

The *S*s were 278 undergraduate college students at Temple University. The birth order and sex distributions are presented in Table 1.

The *S*s were presented with 13 concepts, and asked to rate each concept on three semantic differential scales: beautiful-ugly, which represents the evaluation factor; fast-slow, which represents the activity factor; and strong-weak, which represents the potency factor.[2] The greatest discrepancy any *S* could have per scale is six, which would occur if he rated his real self "1" and his ideal self "7." Thus, the maximum possible discrepancy score was 18, with the minimum possible score being zero, since *S* could rate his real self and ideal self the same. The real self concept was titled "Myself as I am," while the ideal self-concept was titled "Myself as I would like to be." Another concept, "The average college student," was also rated by *S*s, with the hope being that discrepancies on this concept from real self or from ideal self would prove useful by providing a social baseline against which to compare the real self and ideal self ratings. However, the vast majority of *S*s rated the average college student at four, the midpoint, so little use could be made of ratings on "the average college student." Instructions at the top of the sheet containing the concepts and semantic differential scales informed *S*s that we were interested in how people rate concepts. *S*s were not volunteers, who are known to be different from nonvolunteers in various ways (13), but were tested in their classrooms with the cooperation of their instructors.

2. *Results*

Table 1 shows the birth order and sex groupings for high and low self-esteem *S*s. Since the modal discrepancy score was three, *S*s at or below this score were defined as high self-esteem *S*s, while *S*s with discrepancy scores in the 4-18 range were considered low self-esteem *S*s. As so defined, 60 percent of

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[2] The other concepts which *S*s rated have not as yet been analyzed. They were symmetry, physically disabled, conformity, cat, dog, counselor, therapist, novelty, complexity, and L.S.D. Beautiful-ugly loads .86 on Evaluation, .09 on Activity, and .01 on Potency. Fast-slow loads zero on Evaluation, .70 on Activity, and .01 on Potency. Strong-weak loads .19 on Evaluation, .20 on Activity, and .62 on Potency.

TABLE 1
HIGH AND LOW SELF-ESTEEM FOR BIRTH ORDER AND SEX GROUPINGS

	Number of *S*s	
Birth order and sex	High self-esteem (0-3 discrepancy)	Low self-esteem (4-18 discrepancy)
Only child males	16	8
Only child females	16	8
Firstborn males	42	24
Later born males	26	14
Firstborn females	46	26
Later born females	20	32[a]

[a] For later born females $\chi^2 = 8.04$, $df = 1$, $p < .01$.

the *S*s were in the zero-3 range and 40 percent in the 4-18 range. Chi squares had to be based on expected frequencies based on a 60-40 split, rather than the usual 50-50 split. As shown in Table 1, the only significant effect occurred for later born females, who had lower self-esteem than would be expected on a chance basis. In fact, later born females were the only *S*s who more often had discrepancy scores in the 4-18 range. All other birth order-sex groupings had more scores in the low discrepancy (zero-3) range.

It is interesting to note that there were significantly more firstborn *S*s in the sample than there were later born *S*s: 138 firstborns and 92 later borns ($\chi^2 = 9.20$, $df = 1$, $p < .01$). This finding is consistent with the findings of other investigators that there is sometimes a tendency for firstborn *S*s to be overrepresented on college campuses: i.e., there may be more firstborn *S*s who attend some colleges than later born *S*s in attendance.

3. *Discussion*

The results support the methodological warning advanced in the introduction. Had the self-esteem scores been analyzed by sex alone or by birth order alone, negative results would have appeared. However, it seems that the combination of being both female and a later born child leads to low self-esteem, at least as measured by the discrepancy between the real self and ideal self measures utilized in the present investigation.

The results are somewhat surprising; we might have anticipated that firstborns would have high self-esteem, but any advantage that firstborn *S*s have in the present study as regards self-esteem is not so much due to their high self-esteem as it is based on the relatively low self-esteem of the later born females. Firstborn children are often a great joy for their parents, and may have been eagerly anticipated. In contrast, the later born child is not a unique entry into the parents' home, and he may be valued less than the firstborn. With regard to sex, males occupy many more positions of power and prestige in our society than do females. Perhaps the combination of being both female and later born is particularly conducive to low self-esteem.

Numerous studies using various self-esteem measures have reported findings consistent with expectations (5). However, there are some questions to be kept in mind about any attempt to measure self-esteem. The relationship between self-esteem and adjustment appears to be curvilinear rather than linear (2, 3). High self-satisfaction may represent defensiveness rather than true satisfaction with the self. Second, one should not necessarily expect different measures of self-esteem to yield the same findings. While it is hoped that all measures of a given construct would show high intercorrelations, the author's own research into creativity measures (7) shows that this is not always the case. Third, even with a single measure of self-esteem, we do not necessarily know what it is that that test is measuring. This is shown by a recent methodological study by Berger (1) in which a factor analysis of self-esteem questionnaire items for 298 undergraduates yielded five identifiable factors: Communicative Propensity, Other-Anxiety, Negative Self-Evaluation, Positive Self-Evaluation, and Other-Certainty. In addition, a separate analysis of female data for various self-esteem items showed that Negative Self-Evaluation and Other-Certainty formed a single dimension. Berger's interpretation was that part of females' self-esteem is based on their certainty that others like them. Berger's investigation is the kind of work that needs to be done so that we might better understand what a given construct is all about.

Despite these three warnings, it is possible to have some confidence in the meaning of the self-esteem construct as here measured if it can be shown to relate meaningfully to something else. The "something else" in this case is prejudice against the physically disabled. Low self-esteem *S*s are predicted to be more prejudiced against the physically disabled because the physically disabled, by nature of their disability, are deviant. The low self-esteem *S* should want to conform to others to have them reward him, since he rewards himself but little. Consequently, the low self-esteem *S* should go along with the prejudices of the culture to a greater extent than the high self-esteem *S*. It is here maintained that one of the prejudices of our culture is a dislike of the physically disabled because they are so different from the norm, and are so different from our great emphasis on beauty and being attractive (8, 14). Study II was undertaken to see if self-esteem was related to prejudice against the physically disabled, and to see if there was any relationship between such prejudice and the demographic variables of birth order and sex.

C. STUDY II

1. *Introduction*

Prejudice is sometimes defined as prejudging, but it is also used to mean unfavorable attitudes held toward another, or judging another negatively based on stereotyped qualities of that other. Any of these definitions would seem to be consistent with the method used in the present study. If someone reacts to an opponent who is not physically disabled and also to an opponent who is physically disabled, the basis of evaluating the opponent could be (*a*) the opponent's behavior and (*b*) the fact that the opponent is physically disabled. If we hold (*a*) constant and have a control opponent where (*a*) is also held constant, then we can have an indication of prejudice against the physically disabled if *S*s rate the physically disabled opponent as less capable than the nonphysically disabled opponent, despite equal performance. The present method is based on one successfully used by Eisenman and Townsend (10) to investigate prejudice against the physically disabled.

2. *Method*

The *S*s were 300 undergraduates at Temple University. Birth order and sex data are shown in Table 2.

*S*s were run in groups of approximately 10-15 *S*s at a time. Each *S* was

TABLE 2
NUMBER OF *S*S BY BIRTH ORDER AND SEX RATING THE PHYSICALLY DISABLED OPPONENT WORSE THAN, EQUAL TO, OR BETTER THAN THE CONTROL OPPONENT

Birth order and sex	Worse	Equal	Better
High self-esteem			
Only child males	4	5	3
Only child females	4	5	4
Firstborn males	9	15	10
Later born males	9	13	11
Firstborn females	10	14	12
Later born females	6	8	8
Total	42	60	48
	$\chi^2 = 4.36$, $df = 2$, $p < .20$		
Low self-esteem			
Only child males	5	3	1
Only child females	6	6	2
Firstborn males	15	9	4
Later born males	13	10	4
Firstborn females	15	11	3
Later born females	26	12	6
Total	80	50	20
	$\chi^2 = 36.00$, $df = 2$, $p < .001$		

informed that he was going to play a game involving guessing skill. He was told that a computer had generated an ordering of colors, such that on trial 1 "red" might be the correct answer, on trial 2 "blue," etc. This communication and subsequent communications from *E* to *S* were presented individually (while there were other *S*s seated nearby, *E* spoke with each *S* one at a time and out of hearing range of the others). *S*s were told that after five practice trials they would have five regular trials to determine whether or not they could beat an opponent. The opponent was said to be arbitrarily chosen from among the group that had previously taken the test. In the control condition the opponent was described as "another Temple student," while in the experimental condition the opponent was described as "another Temple student who is physically disabled." Occasionally, *S*s asked for more information about the physically disabled opponent, or about the control opponent, but in all cases *E* said that no further information could be provided. *S*s were informed that they had gotten two of the five colors correct on the practice trials. Which trials were reinforced in this manner was random, except that when *S*s mentioned very unusual colors they were told they were incorrect, in order to avoid making *S*s suspicious. During the five regular trials *S*s were told that they had gotten anywhere from zero to three colors correct. However, they were also told that their opponent had gotten the same number correct. Half of the *S*s "played" against the physically disabled opponent first, and half against the control opponent first. No order effects were found.

As the dependent measure, *S*s were afterwards asked to rate how good they believed their opponents might be in a future game, should they (*S*s) and the opponents play again at some later date. The ratings were on a 1-to-7 scale with 1 defined as "much better than me" and 7 as "much worse than me." Since there is no information to go on to discriminate the effectiveness of the physically disabled opponent from that of the control opponent (both opponents played equal to *S*, who always got the same number of colors "correct" against both opponents), rating the physically disabled opponent as less effective than the control opponent is considered prejudice, based on the fact that he is said to be physically disabled.

Of course, there was actually no control or physically disabled opponent, and the whole game was contrived to see if *S*s would rate someone worse simply because he was supposed to be physically disabled. A kind of reverse prejudice would occur if *S* rated the physically disabled person as a better future opponent than the control opponent. Although a small rating difference between the rating given the physically disabled opponent and the control opponent might be random fluctuation for any given *S*, consistent differences in ratings would show the operation of prejudice. Study II utilized the same self-esteem measure as Study I.

3. *Results*

Table 2 shows the findings for the various birth order-sex groupings, and in terms of high and low self-esteem. For this second sample of *S*s, the zero-3 range of discrepancy scores represented 50 percent of the sample instead of 60 percent as in the first study. It can be seen in Table 2 that high self-esteem *S*s were essentially random in rating the physically disabled opponent inferior to, equal to, or better than the control opponent. However, among the low self-esteem *S*s, a highly significant chi square of 36.00 was obtained, which with 2 *df* is significant beyond the .001 level. This significant finding is consistent with the prediction, since low self-esteem *S*s tended to rate the alleged physically disabled opponent inferior to the control opponent.

Self-esteem and being a female later born were found related in Study I, with later born females tending to have low self-esteem. However, there was no significant tendency for later born females to be more prejudiced against the physically disabled than any other birth order-sex grouping. Self-esteem was the only variable associated with prejudice against the physically disabled. Birth order and sex were not related to such prejudice, either singly or in combination.

Also, the finding from Study I of the greater number of firstborn *S*s relative to later born *S*s did not reappear in Study II.

4. *Discussion*

The findings in Study II suggest that low self-esteem may be associated with prejudice. While the data do not permit us to say why this finding should occur, the basis of the prediction was that low self-esteem *S*s tend to conform to the prejudices of the greater culture in order to get acceptance, and thereby raise their self-image. However, it may be that they do not want to change their low self-esteem, but simply to be more accepted. That is, perhaps low self-esteem *S*s wish to maintain their lowly image of themselves, but would like to have some of the fruits of life that self-esteem is positively correlated with. Therefore, low self-esteem *S*s may be persuasible and conforming in order to get acceptance from others. An alternate interpretation is that the idea of physical disability is particularly threatening to low self-esteem *S*s. Perhaps low self-esteem people have very negative body images, and tend to downgrade and avoid the physically disabled, whose disabilities remind them of their own perceived bodily imperfections.

The fact that later born females show low self-esteem on the measure utilized in this research seems established. From Table 2 it can be seen that in Study II later born females once again tended to score low in self-esteem. There were 22 high self-esteem later born females and 44 low self-esteem later born women ($\chi^2 = 7.33$, $df = 1$, $p < .01$). Yet, despite the fact that later born females tend to score low in self-esteem, and self-esteem tends to be associated with prejudice, later born females were not notably prejudiced. This finding is reminiscent of the results obtained by Eisenman and Townsend (10) relating creativity, self-esteem, and acquiescence. Low self-esteem was found related to acquiescence, but creative *S*s with low self-esteem tended not to engage in acquiescence response set. These kinds of findings suggest that simply because people A have trait B, and trait B is associated with C, we cannot believe that people A will necessarily have C. This point should help prevent one from jumping to unwarranted conclusions. Of course, sometimes the A-C connection will hold. Perhaps self-esteem is an area where it is especially likely that not all low self-esteem people will show the typical correlates of low self-esteem.

Of the 300 college students in the second study, 110 rated the physically disabled opponent and the control opponent the same. Rating both the same would seem to be the most rational behavior, given the fact that the only difference between them is that *E* says one is physically disabled. Just as it is considered prejudice *against* the physically disabled to rate them lower when their performance is equal to the nondisabled, it is prejudice *for* them to rate them better when they show equal performance. One wonders just how "pro-physically disabled" are *S*s who rate the physically disabled better when their performance is not better. Perhaps these *S*s really harbor negative feelings toward the disabled, and therefore expect much less of them. When a physically disabled person equals the performance of a nondisabled person, the physically disabled person is seen as having done more than the normal person. Positive stereotypes need to be investigated in connection with research on prejudice just as do negative stereotypes. Both may be damaging as far as ever truly accepting the stereotyped person is concerned.

D. Summary

Two studies were carried out with 278 and 300 college students. In the first study, it was found that later born females tended to have significantly lower self-esteem than expected. Self-esteem was measured by the discrepancy between real self and ideal self on semantic differential scale ratings. Study II replicated this finding, since later born females again had significantly low

self-esteem. However, the major finding of the second study was that low self-esteem was associated with prejudice against the physically disabled. Later born females were not notably prejudiced against the physically disabled, despite their low self-esteem. Several methodological points are made about the measurement of sex, birth order, self-esteem, and prejudice.

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THE HOMEOSTATIC AND COMFORT PERCEPTUAL SYSTEMS*

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A. INTRODUCTION

If we use the following criteria for determining the existence and number of perceptual systems, it would seem that not all of the perceptual systems have been identified. We start with the definition that says perception is the immediate discriminatory response of the organism to energy that impinges on sense organs. We distinguish between sensation and perception by saying that sensation is a form of awareness that has traditionally been assigned to the activation of a specific class of sense organs and the sensory mechanisms they feed into. Perception is the use of data provided by sense organs to cope with conditions either outside or inside the body. Perception is the expression of a direct relationship between the organism and its surrounds, or the response to conditions within the body via receptors (1). There may or may not be sensation involved in perception, and as Gibson (3) puts it, sensation is passive while perception is active.

Pieron (4) and then Gibson (3) have isolated five modes of attention which they state as listening, touching, smelling, tasting, and looking. These along with the fact of how the physical environment is constituted determine the perceptual systems. The environment provides several forms of energy—mechanical, thermal, chemical, and photic energies. Most of these impinge in several ways, and it is these ways that sensory mechanisms must cope with. First of all, there is the gravitational system. This is a broad ever-present, three-dimensional system of force, involving our relations to static supports and carriages. The earth (floor, etc.) supports us and, in effect, draws us to it. This requires that we have means of maintaining posture, both static and ambulatory. This gives rise to what Gibson calls the basic orientation perceptual system.

Likewise, other forms of energy give rise to other forms of response: namely, haptic, savory (taste-smell), auditory, and visual.

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Sensory physiologists and sensory psychologists have used four criteria for determining the existence and number of sense modalities. They are (*a*) a unique class of sensation (awareness), (*b*) a unique sense organ, (*c*) a specific form or range of energy, and (*d*) a separate path from sense organ to brain. Up to now 10 separate sense modalities are recognized, despite the fact that not all these 10 quite meet all the criteria. For example, the vestibular mechanism does not have a specific experience (sensation) connected with its normal function under the usual set of conditions.

Furthermore, if we consider the organism in action—that is, if we consider function—we find that several senses, not just one, are required to perform certain basic functions: i.e., to carry on perceptual response. For example, in basic orientation, it is not the vestibular system alone that is required for maintaining static posture. The kinesthetic and visual systems routinely are involved in a primary way, although any two of the three mentioned mechanisms are able to maintain effective posture.

All of this leads to the conclusion that in any case that a new set of receptors is found, it poses the question of whether a new sensory mechanism—i.e., the naming of a new sense—must be recognized. As a result, it may be appropriate to name a new perceptual system.

It so happens that we now have a number of receptors within the body that have been isolated, and functions attributed to them, but they have not been labelled as parts of a specific sense modality. We simply have one or more senses that have not yet been named. Since they are not named, they are not treated as senses.

B. The Homeostatic System

When we speak of sensation and perception, we most often think of awareness and of reaction to the environment outside the body. Actually, however, the literature does distinguish between two types of reception. It indicates that there are interoceptors and exteroceptors. The one has reference to events within the body and the other, reference to those outside the body. The receptors that have been isolated, but have not been looked upon as components of named sense departments, have to do with body states and internal action.

The receptors to which we allude are (*a*) *carotid sinus receptors* in the cardiovascular system, (*b*) *sensory endings* in the walls of venae cavae and pulmonary veins, (*c*) *sensory cells* in the supraoptic and paraventricular nuclei, (*d*) *thermo-sensitive neurons* in the hypothalamus, and (*e*) certain *receptors* in the tracheobronchial tree which respond to pulmonary inflation and deflation. It is obvious that these receptors participate in the form of body regulation that is known as *homeostasis*.

The overall process of homeostasis includes other aspects besides those in which some condition activates a neural mechanism and it, in turn, innervates tissue, such as smooth muscle. So we are not saying that homeostasis, as such, is only a perceptual performance. We are saying simply that one aspect of the overall maintenance of equilibrium meets the prescription contained in the definition of perception: namely, that it is a response of the organism as a unit mediated by sense organs.

As an advance in our thinking, I would suggest that these receptors be seen as part of a perceptual system which would be called the *homeostatic perceptual system,* for they are involved in what is now recognized as homeostasis. This would do no violence whatsoever with the original concept of homeostasis, for it would not be extending homeostasis beyond the definition given it by the physiologist (2) who first used the term. Homeostasis would still pertain to the processes whereby a stable cellular environment would be maintained. It would not refer to higher-order processes which underlie thinking, speech, and the other behaviors that are generally called psychological and which may act contradictorily to those that maintain equilibrium. But the receptors and what they relate to meet all the criteria of a perceptual system.

The justification for speaking of the system as perceptual would rest on the fact that receptors or sense organs are involved, as in the case of the 10 fully recognized sense departments, that the overall function served is discriminatory, and that it participates in the maintenance of organic unity.

C. THE COMFORT SYSTEM

Once the homeostatic perceptual system is recognized, there is still another system to be included. It is the comfort system, and the justification for identifying it as a separate perceptual system rests on the same rationale as was just used for the homeostatic perceptual system and the other perceptual systems: namely, that it is a system that meets certain demands via sense mechanisms. It effects a natural adjustment to conditions found both within the body and in the environment.

It will be recalled that Gibson (3) used the demands of the environment as a criterion for identifying and determining the number of perceptual systems. For example, the basic orientation system arose to cope with the nature of the gravitational field. The perceptual system for basic orientation was thus externally determined and the crucial mechanisms involved turned out to be several—the vestibular mechanism, the kinesthetic mechanism, and the visual mechanism. The haptic perceptual system likewise arose from environmental demands, in this case to respond to mechanical contact, impact, and for exploring the surface, texture, hardness, and softness of objects. The savory system of taste and smell arose to cope with or take advantage of the nature of chemical and gaseous material in the environment. Organs (ears) developed to respond to and capitalize on fine high frequency pulsations (vibrations) in the environment. Eyes and the visual machinery evolved to take advantage of photic radiation.

It will be noticed that while these determining conditions were in the external environment, the homeostatic system developed to maintain stable internal conditions. One thing yet remains. *Well-being is not all handled by the basic processes called homeostatic.* Part of well-being is quite significantly related to external conditions, such as temperature, etc. This involves mechanisms giving rise to awareness, the production of experiential bodily comfort. Awareness, bodily (regulatory) adjustments, and the overt actions that are taken to produce or maintain comfort lie above the sheer bodily adjustments that provide the conditions for appropriate cell activity. The temperature regulating mechanism like all other visceral mechanisms can be conditioned, which is to say modified, by a basic learning process involving the association areas of the cerebral cortex. It is not simply a reflex mechanism segregated from the activity of the organism as a person.

Thus, I would identify a comfort system as an additional perceptual system. It would lie in the hierarchy between the homeostatic and the five currently recognized perceptual systems.

It would seem that the sensory mechanisms involved are the senses of pain, temperature, kinesthesis, and touch, and even some of the receptors involved in homeostatic processes. Kinesthesis, for example, comes into play in reflecting the state of the muscles. General, mild (or not so mild) discomfort often exists in the form of muscle tensions and aches. The effectiveness of many things, such as aspirin in producing an overall state of comfort, comes by way of relief from this muscular malaise. We know, of course, that aspirin changes blood chemistry. This may, in turn, change muscular state or state of sensory endings in muscle, for the initial discomfort (to the extent that it can be localized) is localized there, and this is alleviated.

D. Discussion

A number of years ago, Stagner and Karwoski (5) published a general textbook in psychology in which homeostasis was brought in as a kind of explanation for the various characteristics of behavior generally dealt with in a standard text.

In their preface to the student they say the following: "But we have worked hardest to provide the student with something we consider absolutely vital. This is the broad over-all view, the organized picture of man and his nature. Students inevitably develop—apparently, they *must* get—this broad, general conception of psychology. Rather than leave this development to chance, we have deliberately written into the book a systematic organization of psychological facts around the principle of homeostasis."

The trouble with what these authors did was that they extended homeostasis out of its original specific context which was given clear definition by Cannon (2) who originated the term. What Stagner and Karwoski apparently saw in homeostasis was a synonym for *equilibrium* itself. They made a generic term out of a clearly defined species term. Utilizing a proper generic term would have possibly been very good, but it was not recognized that the species term they seized upon involved a description that went with it. This description pertained to the maintenance of a proper environment for cell activity. It did not pertain to a number of things to which the authors applied the term.

Since we know that all that the human individual does is certainly not conducive to biological survival, we must go outside of homeostasis to account for a number of his acts, the most abrupt and extreme example being suicide.

This does not mean that we in our thinking sever the vegetative processes from consideration in dealing with behavior (action on the personalistic level). It means that homeostasis should be seen in the proper relation to the other processes and the various acts of behavior. It must be brought in where it belongs and be restricted to its definition.

The delineation of a homeostatic *perceptual* system rests on the fact that *receptors* are involved in part of homeostatic function. The justification of a comfort perceptual system is that awareness and receptor mechanisms are involved together in maintaining the state which can be called comfort or well-being. This is not a gratuitous or redundant imputation if we use the criteria used for the other perceptual systems.

A look at the seven perceptual systems instead of the more customary five will show that we now have a consistent hierarchy of functional machinery that, without a break, reaches from the most basic chemical, thermal, and mechanical processes to the very top at which the most subtile, complex, and articulate activities emerge.

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THE EFFECTS OF FREQUENCY AND DURATION OF EXPOSURE ON RESPONSE COMPETITION AND AFFECTIVE RATINGS* [1]

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A. INTRODUCTION

There is evidence (3) showing that the mere repeated exposure of the individual to a stimulus is a sufficient condition for the enhancement of his attraction toward it. In addition to correlational studies, experimental research carried out in this connection consisted mainly of varying the frequency with which an initially novel stimulus is shown to the subject, then obtaining his affective ratings of it. For a variety of stimuli, these ratings were found to increase systematically with exposure.

A tentative explanation of the exposure-liking relationship (1) suggests that the initial appearance of a novel stimulus tenuously elicits a number of antagonistic response tendencies, producing a tension state (response competition). As a tension state, response competition is associated with negative affect. Subsequent exposure to the initially novel stimulus provides the opportunity for some of the response tendencies to be strengthened while others are weakened or crowded out. As one response tendency achieves dominance, response competition is reduced, along with a reduction of the concomitant negative affect.

Response competition occurring in this situation has been measured in terms of the subject's speed of responding during a free association task (1). Under conditions of greater response competition, the various antagonistic responses are of approximately equal strength and because of the mutual blocking of responses the emission of any one of the competing responses is delayed. Under conditions of lesser response competition, the strengths of the various response tendencies are less equal, and the stronger response can rise above threshold more rapidly. Recent evidence (1, 2) suggests that (*a*) greater response com-

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petition is associated with less favorable affective ratings and (*b*) as frequency of exposure increases, response competition decreases.

The present study further examines the effects of mere exposure on response competition and affective ratings. Specifically, it attempts to replicate the earlier effects of exposure on response competition and attitudinal liking while introducing a new variable: duration of exposure. The above explanation describes the reduction of response competition as the result of progressive perceptual differentiation of the initially novel stimulus. Like repeated exposures, an increased exposure time should provide the subject with a better opportunity to single out distinctive cues of the stimulus, to enhance the encoding of the stimulus, and thereby to increase the likelihood of an early emergence of one response as dominant. Thus it is suggested that, holding frequency of exposure constant, increasing exposure time would aid in the reduction of response competition and further enhance affective ratings.

B. METHOD

1. *Subjects*

Sixty-six female *S*s participated in this experiment. These women were all students at the University of Michigan, and were paid $1.25 for participating.

2. *Stimuli*

Stimuli consisted of the set of 12 Chinese ideographs used in earlier exposure research (1, 3). Stimuli were prepared as 35 mm slides and were projected by means of a Nikkoromat projector onto a Daylight projection screen. Seven-point GOOD—BAD semantic scales were used to obtain affective ratings, and a stopwatch to measure response latencies during the free association task.

3. *Procedure*

In the first part of the experiment, *S*s were simply shown the characters. A within-subject design was used. Half the stimuli were presented for 10 seconds per exposure and half for two seconds per exposure. Under each of these two exposure-time conditions, one stimulus was shown once, one twice, one five times, one 10 times, and one 25 times. A different ideograph was used for each of the 10 combinations of frequency of exposure and duration. An additional ideograph (hereafter referred to as the zero-frequency stimulus) was not shown during the exposure phase, only during the test phase to effect a comparison between stimuli shown once and a completely novel stimulus. A twelfth stimulus was employed for warm-up purposes.

A counterbalanced design was used, such that each stimulus appeared in each frequency and duration of exposure an equal number of times. The order of presentation was randomized prior to the experiment; the restriction was applied, however, that no ideograph could appear two or more times in succession.

Following the exposure phase, measures of response competition and affective ratings were obtained. To assess response competition, the free association task was employed (1). *S*s were simply told to say the first word that they thought of after the stimulus appeared, and to say the word as quickly as possible. *E* recorded the responses and response latencies. To obtain affective ratings, *S*s were told that the stimuli they had been seeing were Chinese adjectives. They were asked to indicate on the semantic scales the extent to which each character represented something good or something bad. Half the *S*s completed scales with GOOD on the left; the remainder, scales with GOOD on the right.

One half the *S*s engaged in the free association task first, then made the affective ratings. The other *S*s undertook these tasks in reverse order. During the assessment phase, order of presentation was initially randomized with the exception of the twelfth ideograph, which served for "warm-up" purposes and was always presented first. (It had not been shown before and was the same for all *S*s.) As in the exposure phase, the order of presentation of the test characters was counterbalanced to reduce order effects. During the assessment phase, a given *S* responded to the characters in the same order during both the affective rating and free association tasks.

C. RESULTS

1. *Response Competition*

There were two hypothesized effects of the exposure procedures on response competition as assessed by response latencies in a free association task. First, it was expected that with the frequency of exposure held constant, the 10-second stimuli would elicit less response competition than the two-second stimuli. Second, with time of exposure held constant, response competition was expected to decrease as a function of the frequency of exposure.

Since response latencies were not normally distributed, 1000/x transformations were applied. The means of these transformed scores were then obtained, and recomputed into seconds. These recomputed means appear in Figure 1. The significance of the differences among these means was tested with an analysis of variance. The zero-frequency stimulus was treated separately and was not included in the analysis of variance, as such inclusion would make the design nonorthogonal. However, mean response latencies for the zero-frequency stimulus are included in Figure 1 for reference.

The results lend support to both hypotheses. First, in all but two of the frequencies, *S*s responded more quickly to stimuli given 10-second exposure than to stimuli given two-second exposure. In the two cases where this did not occur, the differences were negligible. The overall mean response latency for the two-second exposure was 2.86, while the corresponding mean for the 10-second exposure was 2.66. This mean difference of .20 seconds, when tested against the *S*s × Duration interaction, is significant at the .05 level ($F = 4.75$, $df = 1, 64$).

Figure 1 also suggests that, overall, response latencies tend to decrease as a function of the frequency of exposure. This effect is significant when tested

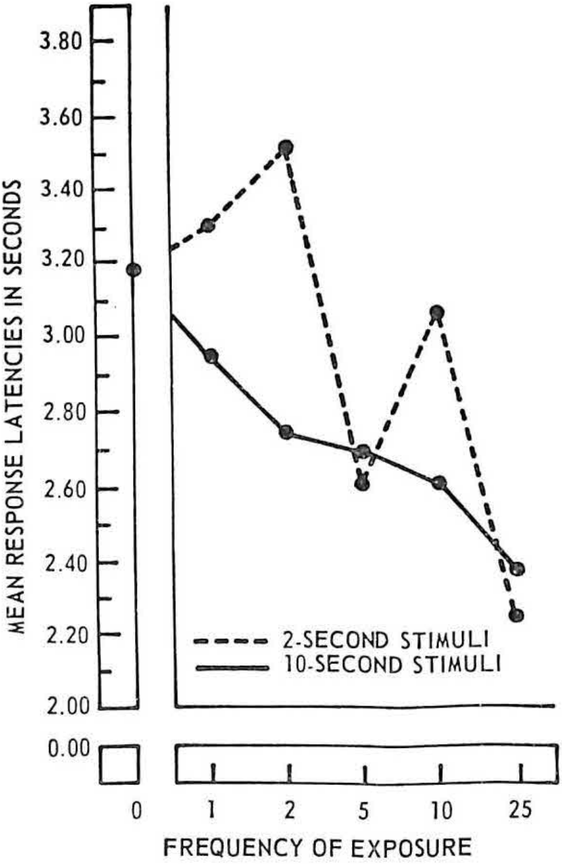

FIGURE 1
RESPONSE COMPETITION AS A FUNCTION OF FREQUENCY AND TIME OF EXPOSURE

against the *S*s × Frequencies interaction ($F = 14.43$, $df = 4, 256$, $p < .001$) and supports earlier findings (1). The Frequency × Interval interaction effect did not attain significance ($F = 1.97$, $df = 4, 256$, N.S.) nor did any other interaction effects. In separate tests the zero-frequency stimulus was found to generate no different latencies from those generated by either the two-second or the 10-second stimuli given only one exposure. In summary, the response latency data suggest that (*a*) 10-second stimuli elicited somewhat less response competition than the two-second stimuli, and (*b*) response competition decreased as a function of repeated exposure.

2. *Affective Ratings*

*S*s' ratings on the seven-point semantic scales were scored from zero to 6 with high numbers indicating greater "goodness." Figure 2 presents the affective ratings as a function of the frequency of exposure under two exposure-time intervals. The significance of these differences was tested by means of an analysis of variance, again, with the zero-frequency stimulus being treated separately.

In correspondence with earlier findings, Figure 2 shows that, in general, affective ratings are enhanced as a function of the number of previous stimulus exposures. Tested against the *S*s × Frequency interaction, this effect is significant at the $p < .025$ level ($F = 2.83$, $df = 4, 256$). No difference was found between the zero-frequency stimulus and either of the two one-frequency stimuli.

Contrary to expectation, Figure 2 does not show increased duration of exposure leading to higher affective ratings. The mean affective rating for the two-second stimuli was 3.28 and that for the 10-second stimuli 3.23. Although the difference is negligible ($F < 1.00$), this ordering of means is not in accordance with the hypothesis. There was, however, a significant interaction effect ($F = 3.86$, $df = 1, 256$, $p < .05$) between duration of exposure and sequence of testing (i.e., whether the subject made the affective rating *before* or *after* engaging in the free association task). The mean ratings of those who completed the affective rating scales *prior to the free association task was* 3.19 for the two-second stimuli and 3.42 for the 10-second stimuli. On the other hand, the mean ratings by those subjects who participated in the free association task first were 3.39 for the two-second stimuli and 3.04 for the 10-second stimuli. This interaction effect was significant at the .05 level ($F = 3.86$, $df = 1, 256$).

D. DISCUSSION

The results of the present study provide support for three hypotheses: (*a*) Response competition is reduced as a result of mere exposure. (*b*) In-

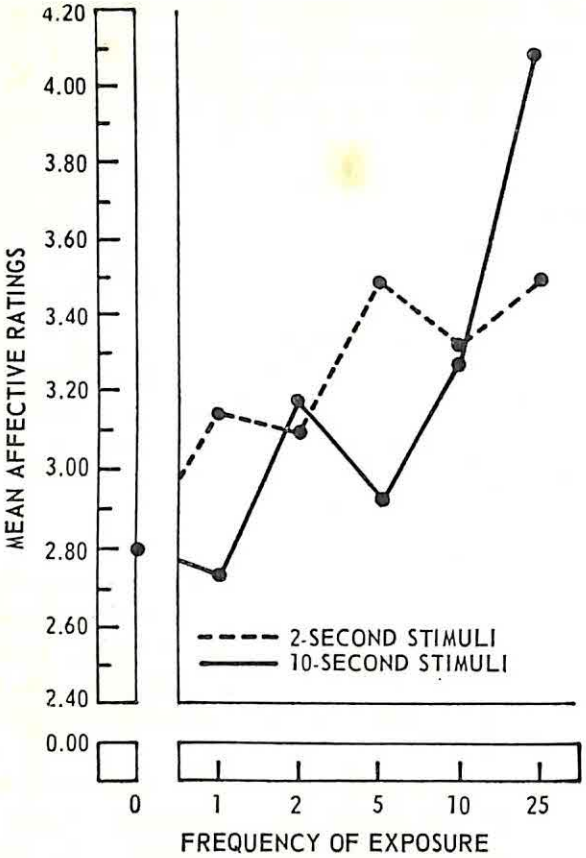

FIGURE 2
Affective Ratings as a Function of Frequency and Time of Exposure

creasing the time interval of exposure aids in the reduction of response competition. (*c*) Affective ratings are enhanced as a function of repeated exposure. The fourth hypothesis, that longer exposure times result in more favorable affective ratings, did not receive clear substantiation. While those who completed affective ratings prior to engaging in the free association task rated the 10-second stimuli more favorably, there was a reverse tendency among *S*s who completed the free association task first. One possibility is that the free association task somehow contaminated the affective ratings. The ratings obtained after an association had been elicited by the stimulus may thus reflect the *S*'s reaction not only to the stimulus but to his association as well. Yet why the free association task should result in a tendency for the *S*s who completed it to award higher ratings to the two-second stimuli is not at all clear. Taking only those *S*s who performed the affective rating without having to give associations to the ideographs, the results do suggest enhancement of affect as a function of duration of exposure. It is also apparent from the results in Figure 2 that on the whole the slope for the 10-second stimuli is somewhat steeper than that for the two-second stimuli. While the appropriate interaction term did not reach acceptable significance level, the trend is inconsistent with the hypothesis. If the prolonged duration of exposure serves to reduce response competition, its effects should be especially pronounced under low frequencies of exposure. Yet for the stimuli shown only once or only five times in training, it is the two-second duration of exposure that results in higher affective ratings. In this respect the latency data (Figure 1) are much more consistent with the expectations. The latencies of associations have a steeper slope for stimuli shown for two seconds than for stimuli shown for 10 seconds. The major differences in these latencies, which favor the 10-second stimuli, occur indeed for low frequencies.

E. SUMMARY

Initially novel stimuli (Chinese ideographs) were shown to 66 subjects in the frequencies of zero, 1, 2, 5, 10, and 25 exposures. Half of the stimuli were presented for two seconds per exposure, while the remainder were shown for 10 seconds per exposure. Consistent with earlier findings, measures of response competition obtained from the latencies of free associations and measures of affective ratings revealed response competition decreases with increasing frequency of exposure, while affective ratings increase. Response competition was also found to be reduced by an extended duration of exposure, but duration of exposure did not have entirely clear effects upon affective ratings. Affective ratings of the stimuli were enhanced by a prolonged exposure only when they were collected prior to securing associations to these stimuli. It is suggested that when ratings are collected afterwards, the association given by the subject contributes to his rating of the stimulus.

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INFLUENCE OF INFORMATION FEEDBACK ON PAIRED-ASSOCIATE LEARNING*

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A. INTRODUCTION

In the method of paired-associate (PA) learning by anticipation, a certain constant interval elapses between the stimulus and response terms, and *S* responds by trying to anticipate the latter during this interval. Subsequently, with the exposure of the response term, *S* receives information on whether he has responded correctly. The question whether the delay preceding this information feedback (IF) influences the speed of PA learning has theoretical importance. The results produced by two previous attempts to answer this question are conflicting. Champion and McBride (2) found a two-second delay to be more effective than a five-second delay, but Kintsch and McCoy (7) failed to obtain a reliable difference among the IF delays of zero, four, and eight seconds. However, the conclusion from neither study is acceptable as the methods employed in both are at marked variance with the usual PA procedure. Kintsch and McCoy divided their stimuli into two groups and called for one response to all members of one group and another response to all members of the other group. On the other hand, the stimulus and response terms of each pair used by Champion and McBride had a strong pre-existing associative connection. The experiment reported in this paper approaches the same problem by a procedure which is free from the above defects.

B. METHOD

1. *Subjects*

Sixty male undergraduate students drawn from several junior and senior psychology classes volunteered as *S*s. They were randomly divided into three groups of equal size.

2. *Apparatus and Material*

The PA stimuli which consisted of six pure tones of varied cycle frequencies were derived from a General Electric frequency generator and recorded

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on a magnetic tape by a single-track Tandberg tape recorder. Subsequently, this magnetic tape was played back to S through a pair of Sharpe high-fidelity dynamic liquid-filled earphones, whereas the words serving as response terms were exposed on a table-view projection screen by a Leitz Pradovit slide projector equipped with remote control and automatic return mechanism. The assembly set up for obtaining printed record of verbal response latencies with a .1-second resolution included one Scientific Prototype audio-threshold relay with matching microphone, three DPDT latch relays, one Sodeco serial-entry print-out counter, one 40-ms pulseformer, and one 10/second Forringer pulse stream generator. Another assembly consisting of a Scientific Prototype LDR audio-switch, four Hunter interval timers, two 40-ms pulseformers, one DPDT latch relay, and one 26-V, 5-amp DC power supply assisted in programming the cycle initiated by each stimulus presentation. A part of this latter assembly was used in relaying and timing the tones during tape recording. As S and E were in adjoining rooms, a second microphone was set up in line with an amplifier and a loudspeaker to convey S's responses to E.

The six pure tones were of the following cycle frequencies: 410, 535, 695, 900, 1170, and 1520. Spaced by a Δ/S ratio of .3, these tones are well within the range where the Weber fraction is generally considered to be stable. The six common words used as response terms are *act, cry, vex, low, gun,* and *zip*. A single magnetic tape on which a four-trial randomized stimulus sequence was recorded by continuous repetition was used with all *S*s.

3. *Procedure*

For all *S*s the rate of stimulus presentation was one in 18 seconds, and the durations of stimulus and IF were, respectively, 1.5 and two seconds. Each group of *S*s was treated with one of the following response-IF intervals: 1.5, 4.5, and 7.5 seconds. Since these intervals were initiated by the audio-threshold relay at the start of responses, with the consideration of .5 second as the time approximately covered by a response, it may be assumed that the actual IF delays were just about one, four, and seven seconds. When S failed to respond within 5.5 seconds from stimulus onset, the audio-threshold relay was automatically disengaged and IF was furnished after an interval of 1.5 seconds.

All *S*s received 15 trials. The intertrial interval being the same as the interval between successive stimuli, the trials were continuous. As usual in PA learning by anticipation, a signal for starting to anticipate was provided after the entire list was exposed once. The *S*s were instructed to be prompt and to guess in the event of uncertainty. All responses were recorded by *E* in a sound-proof room with a constant temperature of 70°F.

C. Results and Discussion

The learning curves plotted with the group means of both correct response frequencies (Figure 1) and average latencies of correct responses (Figure 2) in the five trial blocks clearly indicate a retarding effect of IF delay. This observation is borne out to be reliable by the results of two 3 × 5 analyses of variance. The *F* ratios are, respectively, 2.96 ($p < .05$) and 3.27 ($p < .05$) for IF delay (*df* 2,57) and 27.18 ($p < .01$) and 10.55 ($p < .01$) for trial block (*df* 8,228). Neither analysis shows the IF delay × trial block interaction to be significant.

The results of the present experiment are in agreement with the findings

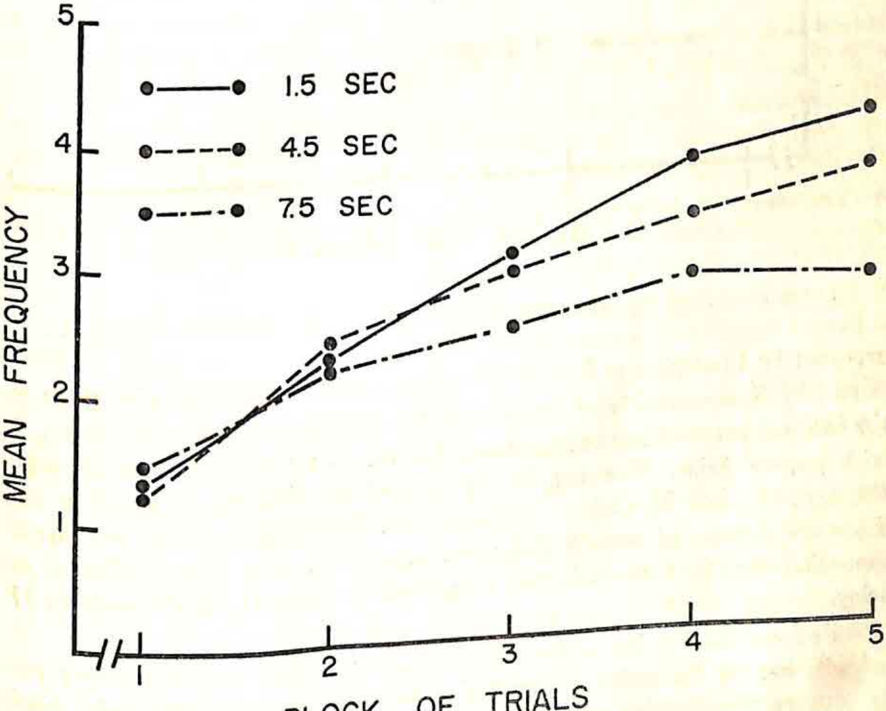

FIGURE 1
Learning Curves Plotted with Mean Correct Response Frequencies for the Three IF Delays

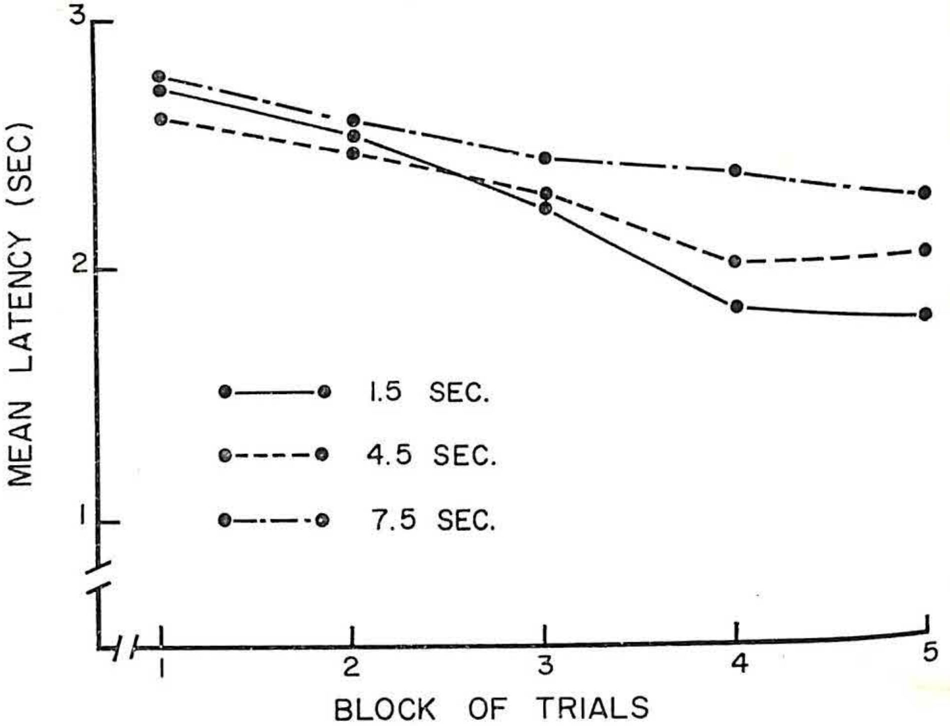

FIGURE 2
Learning Curves Plotted with Mean Latencies for the Three IF Delays

reported by Champion and McBride (2) and in disagreement with those reported by Kintsch and McCoy (7). In the present experiment, constancy in the interval between successive stimuli has led to a confounding of IF delay with post-IF delay. However, in the light of the findings of Bilodeau and Bilodeau (1) and McGuigan, Crockett, and Bolton (9) which demonstrate the ineffectiveness of post-IF delay in motor learning, it is reasonable to assume that the effect shown in this experiment is primarily attributable to IF delay.

An assumption serving as the starting point in several verbal learning theories is that the formation of association between successive rote serial items or between the stimulus and response terms of a PA list is analogous to the development of conditioned response (4, 5, 6, 8, 11). This assumption receives support from the clear evidences of experimental extinction in PA learning as reported by Peak and Deese (10) and Dey (3). It receives further support from the demonstration of an inverse relationship between IF delay and rate of PA learning in the present experiment.

D. SUMMARY

Two previous studies of feedback delay in PA learning have produced conflicting results. In the present study which, unlike its predecessors, has strictly adhered to the conventional PA method, feedback delays of approximately one, four, and seven seconds were applied, each to a group of 20 *S*s in the practice of a list of six tone-word pairs through 15 trials. The analyses of both frequency and average latency of correct responses have revealed a significant retarding influence of feedback delay on acquisition rate. This finding is consistent with the analogy of verbal associative response with conditioned reaction.

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AUDITORY AND ILLUMINATION EFFECTS ON VISUAL CLOSURE AS PREDICTED FROM BRAIN BLOOD-SHIFT THEORY*[1]

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A. INTRODUCTION

Brain Blood-Shift Theory was first named in the experimental literature in 1965 by C. Chyatte (4). The theory rests on evidence of the localization of various functions in the brain. This notion has been widely supported (2, 3, 10).

The theory distinguishes between massive blood shift to the brain and localized blood shift within the brain. An example of localized blood shift was seen by Darrow and Graf (9), who, using cats with surgically implanted cranial windows of glass, saw reddening and blanching of the cerebral cortex in response to dosage of drugs, to hyperventilation, and to temperature change. An example of superficial massive blood shift is seen when facial blushing occurs as the result of embarrassment or laughter. Evidence for massive and localized blood shift has been summarized by J. Macro and C. Chyatte (13) and C. Chyatte, K. Coulson, and B. Anderson (7).

According to Brain Blood-Shift Theory, adjacent areas of functional localization in the brain compete for the limited supply of blood in their vicinity, and that activation of any small sector of the cortex will deprive adjacent tissues of metabolites and thus inhibit their function. The difficulty people commonly have in understanding two or more simultaneous conversations is seen to reflect competition for blood within the limits of the auditory cortex (intratemporal rivalry for blood). Such rivalry, however, is held to diminish with increasing distance between cortical loci. On this basis Chyatte predicted and verified (6) differences in auditory-tactual rivalry based on a blood-shift gradient that deprives cortical tissues most that are closest to the excited locus.

Since sudden sensory stimulation long has been known to result in massive

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[1] This research was a part of a Master's thesis presented to the Department of Psychology, DePaul University, Chicago, Illinois.

blood shift to the brain as a whole (17), C. Chyatte (4) proposed that intersensory facilitation is most probable for those functions mediated by brain parts at some distance from each other; and that intersensory rivalry should be most pronounced for cortical loci that are close together. An experiment by F. A. Courts (8) showing that the learning of nonsense syllables is facilitated by grasping a hand dynamometer supports the prediction of intersensory facilitation for loci at some distance from each other.

In another study using Blood-Shift Theory, D. Chyatte and C. Chyatte (6) stated that the effect of raising stimulus intensity was analogous to bringing cortical loci closer together to produce a greater rivalry for blood. They wrote (6, p. 154) ". . . the cortical blood-shift gradient clearly seemed to widen when stimulus intensity was increased."

With this new notion added, the theory would seem to predict a curvilinear "rise-and-fall effect" on the threshold of one sense modality as another sense (that is, one mediated at some distance cortically from the first) is stimulated by increasing intensities of stimuli. This prediction seems to be supported by Miller (15), who found that high-intensity tones lowered critical flicker fusion threshold and low-intensity tones raised it.

The theory explains the facilitating effect of low-intensity tones as inducing a massive blood shift to all brain areas, thus increasing the amount of blood available to mediate CFF perception. Theoretically, high intensity tones lowered CFF thresholds by generating a wide gradient that locally diverted blood from the occipital lobe to the auditory lobe (i.e., intersensory rivalry).

Other authors have found similar facilitating effects of auditory stimuli on CFF (1, 11), as well as detrimental effects (16).

As one looks at Figure 1 [see Luckiesh (12) for details on the physical properties of the illusion] the white-strip intersections all show grey closure patches *except* the directly fixated intersection which retains its white appearance.

C. Chyatte explained the absence of a closure patch at any directly fixated intersection using blood-shift theory. He stated (5, p. 237):

> maximal blood shift should occur toward the small part of the occipal cortex that is involved in seeing the point of visual fixation in Figure 1. Visual neurons in closest proximity to that cortical locus should suffer the greatest deprivation of metabolities, therefore tend to be unresponsive and locally block the spread of excitation and thus abort the viewer's experience of closure.

He predicted that under ordinary illumination (relatively low stimulus intensity) the effective geometric limits of the blood shift gradient should be

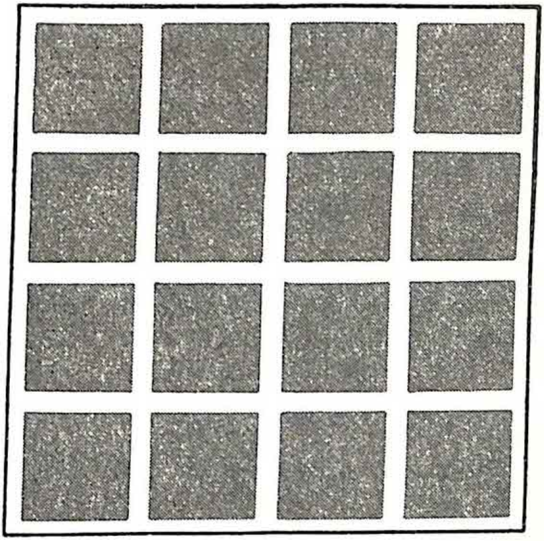

FIGURE 1
CLOSURE ILLUSION

much narrower than those to be expected under more intense local excitation. And so if the distance between the viewer and the figure were increased, this would put the whole occipital area excited by the image within the gradient, and all the patches would fade. It was also predicted that under brighter light (high stimulus intensity) the patches would fade at a lesser distance.

These predictions were verified by D. Chyatte and C. Chyatte (6). They found that under high-intensity light less distance between viewer and the figure was needed for the closure patches to fade than under low-intensity light. As noted earlier, they stated that "the cortical blood-shift gradient clearly seemed to widen when stimulus intensity was increased."

If this is the case that the cortical blood shift gradient widens when stimulus intensity in increased and since Miller's study supports this notion for high intensity tones on CFF thresholds, then we can further predict that high-intensity tones should widen the blood-shift gradient in the occipital cortex (since the amount of blood needed to support the metabolic requirements of the fixation point in the occipital cortex will need to be drained from a wider surround, because the surround has lost some blood to the activated auditory cortex). And in this case, the closure patches in Figure 1 should disappear at lesser distance.

Conversely, we can predict that low-intensity tones should induce massive blood shift to the brain. This should narrow the blood shift gradient around the cortical area of visual stimulation, calling for a greater distance between viewer and figure before the closure patches fade.

It is the primary aim of this study to test the prediction that high-intensity tones will tend to reduce the distance at which the closure patches in Figure 1 fade, and that low-intensity tones will tend to increase the distance for this disappearance threshold.

A second aim is to test the earlier finding of D. Chyatte and C. Chyatte that for high illumination the blood shift gradient would widen and less distance between viewer and Figure 1 would be needed for the disappearance of the closure patches than under low illumination.

B. Procedure

The study is a two by three analysis of variance design, with two levels of illumination and three levels of sound. The subjects fixated their eyes on the closure-illusion figure (see Figure 1) as it was rolled away from and toward them by the experimenter. The distance between the subject and the figure was recorded when the subject reported the point at which the closure patches began to fade or began to reappear.

All subjects reported such thresholds under all six conditions. To ensure reliability, four threshold reports for each condition were obtained and averaged. A rest period after each trial was provided to minimize fatigue. The usual precautions for randomizing conditions and ascending and descending trials were taken.

The subjects were 16 student volunteers, from 12 to 14 years of age. A Beltone Model 10C audiometer was used to present the auditory stimulus. High-intensity tones were taken at 90 decibels at 1000 cycles per second; low-intensity tones were taken at 30 db at 1000 cps. Each subject wore the earphones for every treatment condition, even for the no-sound condition. The bright light condition was taken at 260 foot candles and was provided by a Tensor student lamp. The low light condition was at 32 foot candles, and provided by overhead fixture lights.

C. Results and Discussion

An analysis of variance for a two by three matrix design utilizing repeated measures was computed with the use of procedures outlined in McNemar (14).

A test of the main effect of illumination across all conditions revealed an

F-ratio of 13.91, significant at the .01 level with 1 degree of freedom associated with the numerator and 15 degrees of freedom associated with the denominator. Illumination, indeed, effects a significant difference in the "closure patch threshold" in these data. The main effect of the sound variable across all conditions was found to be statistically insignificant.

An *F*-ratio for the interaction between the two main effects, sound and illumination, was computed to be 8.88. With 2 degrees of freedom associated with the numerator, and 30 degrees of freedom associated with the denominator, this interaction is statistically significant at the .001 level.

This means that while the main effect of sound does not produce a difference upon the "closure patch threshold," sound and illumination combined produce a greater effect than either variable by itself.

Figure 2 graphically presents the interaction of the sound and illumination variables. It appears that under the conditions used, sound enhances the effect of illumination in a rather peculiar way. Under bright light sound enhances the blood shift gradient effects, and under low illumination it disrupts it (see Figure 2).

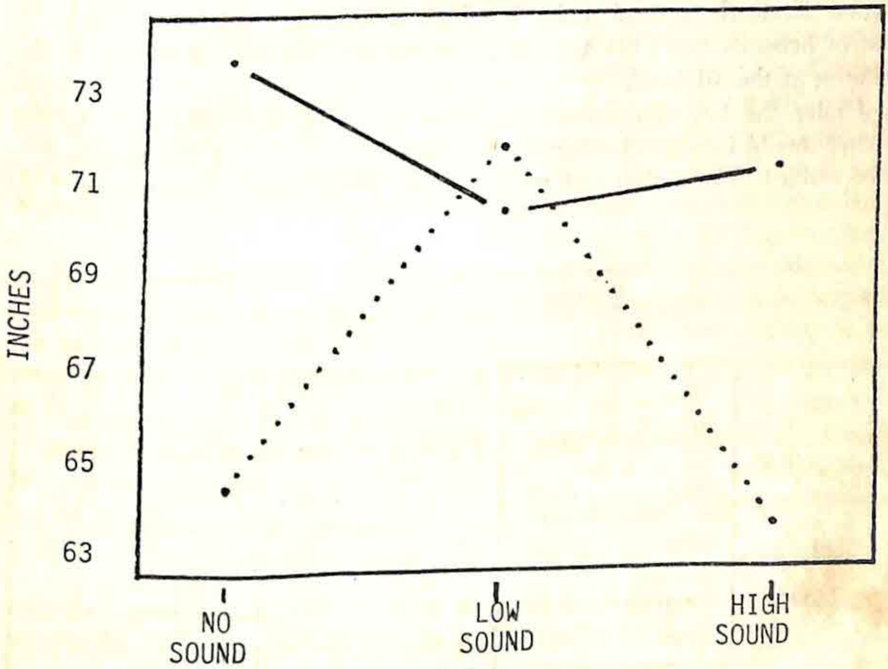

FIGURE 2
MEAN DISTANCE THRESHOLDS FOR 16 *S*s FOR JUDGED DISAPPEARANCE OF CLOSURE PATCHES (UNDER HIGH ILLUMINATION ....; UNDER LOW ILLUMINATION ——————).

Figure 2 seems to show that the relationship of auditory tones upon the "closure patch threshold" is a curvilinear one. This result is in keeping with Miller's study on intersensory effects of sound on the CFF visual perception task. He found (15) a similarly significant (.001 level) curvilinear "rise and fall effect" upon the CFF threshold by varying auditory intensity.

Miller explained his results by postulating that auditory impulses stimulate reticular activity and that this reticular activity in turn desynchronizes groups of "on" and groups of "off" fibers from each other in the visual cortex. Miller further suggested that this curvilinear relationship may be generalized to all intersensory modes. Brain Blood-Shift Theory is consistent with Miller's notions of reticular activation. It accounts for the curvilinear effect on the basis of the interaction between massive blood-shift (perhaps generated by the reticular system) and localized blood-shift gradient effects.

Table 1 presents the means across all 16 subjects and trials under the high and low illumination conditions, with three levels of sound.

The hypothesized Brain Blood-Shift Theory prediction that low intensity tones will tend to increase the distance at which the closure patches will disappear is clearly verified under the high illumination condition. With the use of Scheffe's test (14) the difference between Mean$_2$ and Mean$_3$ is significant at the .01 level.

Under the low illumination condition the prediction that low-intensity sound should increase the distance at which the closure patches disappear is not verified. The author and his colleagues are at present puzzled by these

Table 1
Mean Distance Thresholds (in inches) for Judged
Disappearance of "Closure Patches" by 16 Ss for
3 Levels of Sound and 2 Levels of Illumination

	NO SOUND		LOW SOUND		HIGH SOUND	
HIGH ILLUMINATION	Mean$_1$	64.29	Mean$_2$	71.36	Mean$_3$	63.34
	Standard Deviation	13.86	Standard Deviation	12.55	Standard Deviation	15.63
	Range	37-98	Range	34-111	Range	30-103
LOW ILLUMINATION	Mean$_4$	73.62	Mean$_5$	70.19	Mean$_6$	70.38
	Standard Deviation	17.88	Standard Deviation	10.31	Standard Deviation	13.78
	Range	38-127	Range	41-113	Range	43-110

data and recommend replication to rule out the possibility of experimental error. However, the possibility is that with relatively dim visual stimulation, the extent of the visually generated blood-shift gradient is too narrow for significant interaction to occur with the blood-shift gradient generated by auditory stimulation.

Symons (18), who investigated the effects of such different stimuli as olfactory, nasal breathing, thermal, gustatory, vestibular, auditory, etc. upon visual sensitivity, also found inconsistent results when an auditory stimulus (60 db at 1000 cps) was used. He postulated that cues were available to his subjects which gave them greater encouragement and knowledge of some parts of his experiment than others. It may be that his results also are a function of the auditory intensities employed.

In comparing means from Table 1 with the exception of the 30 decibel level in every case Scheffe's test reveals (.01 level) that under the high illumination condition lesser distance is needed for disappearance of the closure patches. This verifies the earlier findings of D. Chyatte and C. Chyatte (6).

D. Summary

The effects of two levels of illumination and three levels of sound upon the distance of the "closure-effect disappearance (CED) threshold" was investigated for 16 subjects. Several predictions based on a Brain Blood-Shift Theory gradient were tested. It was found that, under the high illumination condition, the data verified (.01 level) the blood-shift gradient prediction that loud tones lowered the closure effect disappearance threshold. However, this prediction was not verified under low-intensity illumination. Auditory stimuli and illumination levels interact significantly in these data (.001 level), with auditory level alone having a statistically insignificant effect on the C.E.D. threshold.

The present data support earlier findings of D. Chyatte and C. Chyatte (6) for illumination and visual closure effects.

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CHILDREN'S SELF-CONCEPT AND KINDERGARTEN ACHIEVEMENT*

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A. INTRODUCTION

Many leading theorists have maintained that the self-concept plays a significant role in the education process (1, 7, 11, 12, 15). The contention is that when a child is accepted, approved, respected, and liked for what he is, he will have an opportunity to acquire an attitude of self-acceptance and respect for himself. With such an attitude he will have the freedom to venture forth into the school situation, and use his intelligence to its utmost capacity. A review of the literature reveals, however, that despite these claims little empirical evidence is available to support these contentions. Wylie (17) has noted that studies in the area of self-concept are filled with conflicting and confusing evidence. She ascribes the confusion to the great methodological difficulties inherent in the measurement of the self-concept, and to the bewildering array of hypotheses, measuring instruments, and research designs utilized.

Most of the research into the self-concept has been concerned with college students. McCandless (13, p. 179) states: "Compared with the number of adult studies, there are few studies of the self-concept in children. Self-concept studies of children younger than about fourth grade age are rare, since each child would have to be examined individually (because of reading and writing difficulties)."

Gordon and Combs (10) pointed out in their review of the literature relating the learner to self and perception, that while the literature contained many discussions of the origins and the development of the child's self, research was scant. They call attention to the pressing need for research both of a longitudinal nature and of normative studies at all development levels, theoretically based upon the development of the self-concept.

Dubin and Dubin (6) also point out the need for research in this area. They state, after a review of the literature, that from a methodological stand-

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point the empirical literature appears inadequate to support broad generalizations by virtue of scatter in theoretical interest and limited research technologies employed. They point out that the complicated processes relating self-concept to behavior have scarcely been studied.

The present study was concerned with ascertaining the relationship between children's self-concept and achievement in kindergarten. It attempted to answer the question: "Does the self-concept have functional utility at the kindergarten level?" It was predicted that girls would be significantly superior in achievement in kindergarten and in their perceptions of themselves than would boys.

B. Subjects and Procedures

The initial population in the present study consisted of 1042 children enrolled in the 37 kindergarten classes of a New York State public school district. At the conclusion of a three-session orientation program held in November, 19 teachers rated their pupils in terms of their judgment of the child's self-perception in the dimensions of competence-incompetence, good-bad, and ego strength. The rating scale used by the teachers for this purpose was scored from zero to 11.

In May the teachers rerated the highest and lowest boys and girls in each class on the same rating scale utilized in November. The teachers' ratings of these 148 children proved to be quite stable—$N = .87$. Criterion groups were established by selecting the 25 highest boys and girls and the 25 lowest boys and girls in this sample.

Those children thus selected were individually administered the Quantified Self-Concept Inventory (16). This sentence completion instrument consists of a series of 40 stems based on the developmental areas used by Gesell and Ilg (9) and developmental tasks as listed by Havighurst (11). The child's responses to each item were coded, when relevant, as reflecting positive or negative self-perceptions. A global self-concept score for each child was derived by dividing the number of positive by the number of negative self-perceptions.

The children who had been identified for further study were also individually administered a nonverbal pictorial self-concept scale, developed by the authors (4)—namely, the U-Scale. This instrument was presented to the child as a game in which the child's task was to select (by pointing) the real "You" in each of 50 pairs of bipolar drawings. Each pair of drawings showed the male or female "You" figure in a positive or negative situation; e.g., "You" being rewarded or rebuked by his teacher. The 50 choices reflect such dimensions of self-concept as appearance, competence, and interpersonal relations. There are separate forms for boys and girls; the content is the same, only the sex of the "You"-figure and other protagonists are different: Each positive choice of the child was scored one point, with the maximum possible score being 50.

In the month of May all children were administered the Metropolitan Readiness Tests as part of the regular school testing program. This test provides scores for (*a*) Word Meaning, (*b*) Sentences, (*c*) Information, (*d*) Matching, (*e*) Numbers, (*f*) Copying, (*g*) Reading Readiness, (*h*) Number Readiness, and (*i*) Total Readiness.

In order that the kindergarten grading system might be adequately analyzed statistically, the four grading criteria utilized by teachers were given numerical weights. Satisfactory received a weight of 3, while Improvement Shown, Improvement Needed, and Unsatisfactory received weights of 2, 1, and zero, respectively. Thus it was possible to compute a Grade Point Average (G.P.A.) for every pupil, based upon the 26 report card categories.

C. RESULTS

The question posed at the onset of the present investigation, "Does the self-concept have functional utility at the kindergarten level?" was answered positively. Table 1 supplies evidence indicating the utility of the various instruments employed in the present investigation in discriminating between the high and low criterion groups. It shows that the Metropolitan Readiness Tests were able to discriminate between high and low boys and girls at the .01 level of significance. Table 1 also indicates that such was the case for Grade Point Average and that the U-Scale discriminated at the .01 level of significance between high and low boys and girls. However, the Quantified Self-Concept Inventory proved to be a poor discrimination between high and low boys and discriminated only at the .05 level of significance between high and low girls.

It was hypothesized that girls would be significantly superior in achievement in kindergarten and in their perceptions of themselves than would boys. Table 2 shows no significant differences on the Metropolitan Readiness Tests (M.R.T.) between high boys and girls, and low boys and girls and also shows no significant differences in Grade Point Average between high boys and girls and low boys and girls.

Table 3 indicates no significant differences in perception of themselves by high boys and girls measured by the Quantified Self-Concept Inventory (Q.S.C.I.). However, the Q.S.C.I. did show a significant difference of per-

TABLE 1
TESTS FOR SIGNIFICANCE BETWEEN MEAN METROPOLITAN READINESS, MEAN GRADE POINT AVERAGE (G.P.A.), MEAN U-SCALE, AND MEAN QUANTIFIED SELF-CONCEPT INVENTORY SCORES OF HIGH AND LOW BOYS AND GIRLS

Subjects	Mean	SD	*f*	*t*
		Mean Metropolitan Readiness Test Scores		
Boys				
High	77.00	9.33	2.65*	7.26**
Low	50.56	15.20		
Girls				
High	76.72	12.04	2.43*	5.43**
Low	52.00	18.77		
		Mean Grade Point Averages (G.P.A.) Scores		
Boys				
High	77.08	1.29	75.51**	6.14**
Low	62.64	11.45		
Girls				
High	77.24	1.30	92.11**	4.67**
Low	65.24	12.51		
		Mean U-Scale Scores		
Boys				
High	39.44	5.97	1.05	5.52**
Low	29.04	5.92		
Girls				
High	36.92	7.40	1.74	4.17**
Low	29.00	5.61		
		Mean Quantified Self-Concept Inventory Scores		
Boys				
High	3.72	3.35	3.85**	.61
Low	3.25	1.71		
Girls				
High	3.39	3.22	5.66**	1.15*
Low	3.00	1.35		

Note: A one-tailed *t*-test was used.
* Significant at the .05 level.
** Significant at the .01 level.

ception of self between low boys and low girls at the .01 level of significance in favor of low boys. Table 3 shows no significant differences in perception of themselves of high boys and girls and low boys and girls, as measured by the U-Scale.

Girls were not significantly superior in either achievement or in their self-perceptions. On the contrary, low boys as assessed by the Quantified Self-Concept Inventory perceived themselves significantly better, at the .01 level of significance, than did low girls. This significant difference in self-perception was not, however, supported by the U-Scale. No significant differenccs between boys and girls were found on the achievement measures.

TABLE 2

TESTS FOR SIGNIFICANCE COMPARING MEAN METROPOLITAN READINESS TESTS (M.R.T.) AND MEAN GRADE POINT AVERAGE (G.P.A.) SCORES OF HIGH BOYS AND GIRLS AND LOW BOYS AND GIRLS

	Mean	SD	*f*	*t*
		Mean Metropolitan Readiness Test (M.R.T.) Scores		
High Boys	77.00	9.33	1.67	.09
High Girls	76.72	12.04		
Low Boys	50.56	15.20	1.52	.29
Low Girls	52.00	18.77		
		Mean Grade Point Average (G.P.A.) Scores		
High Boys	77.09	1.29	1.02	.43
High Girls	77.24	1.20		
Low Boys	62.64	11.45	1.19	.75
Low Girls	65.24	12.51		

Note: A one-tailed *t*-test was used.

D. DISCUSSION

In order to fully comprehend the results of the present investigation, one must take into consideration the unusual nature of the sample studied. Two "criterion groups" were set up by the investigator, based upon teacher ratings of self-concept. These "criterion groups" consisted of the 50 highest self-concept (25 high boys and 25 high girls) and 50 lowest self-concept (25 low boys and 25 low girls) boys and girls. Some idea of the extreme dichotomy that evolved can be obtained when one considers that the "criterion groups" represent the highest and lowest self-concept children derived from an initial

TABLE 3

TESTS FOR SIGNIFICANCE COMPARING MEAN QUANTIFIED SELF-CONCEPT INVENTORY SCORES AND MEAN U-SCALE SCORES OF HIGH BOYS AND GIRLS AND LOW BOYS AND GIRLS

	Mean	SD	*f*	*t*
		Mean Quantified Self-Concept Inventory Scores		
High Boys	3.72	3.35	1.08	.35
High Girls	3.39	3.22		
Low Boys	3.25	1.71	1.59	2.02**
Low Girls	2.00	1.35		
		Mean U-Scales Scores		
High Boys	38.44	5.97	1.53	.79
High Girls	36.92	7.40		
Low Boys	29.04	5.82	1.07	.02
Low Girls	29.00	5.61		

Note: A one-tailed *t*-test was used.
** Significant at the .01 level.

population of 1042. Extreme caution must therefore be exercised in the interpretation of data derived from the study of such a population.

Regarding the functional utility of the self-concept at the kindergarten level, it was demonstrated that at this age level self-concept is related to achievement. It was also shown that teacher judgments of children's self-concept at this early developmental level are predictive of kindergarten achievement, the correlation between teacher judgment and the Metropolitan Readiness Tests being a highly significant .70, significant at the .01 level.

It is of some importance to note that not only were teacher ratings of children's self-concept predictive of achievement at this level, but that teacher ratings of children's self-concept, at least at the extremes, was shown to be stable over a period of time. The teachers were asked to rerate 148 children, as to their self-concept, five months after their initial ratings of these children; a reliability coefficient of .87 was obtained.

The teacher ratings furthermore indicated a definite congruence between their perceptions of children's self-concepts and the child's self-concept, as measured by the U-Scale. The U-Scale measurement attested to the validity of the "criterion groups," which, of course, were based originally on teacher ratings of self-concept. The significant differences, at the .01 level, between high and low boys and girls supplied ample evidence as to the existence of a true dichotomy of self-concept.

It is interesting to note that the verbal instrument utiilzed to measure self-concept in the present study—namely, the Quantified Self-Concept Inventory—showed no such congruence between teacher ratings of self-concept and self-concept as actually measured by that instrument. It is quite apparent, therefore, that the nonverbal measure of self-concept, the U-Scale, and the verbal measure of self-concept—the Quantified Self-Concept Inventory—suggest contradictory findings. The former attests to the validity of the "criterion groups," while the latter invalidates the criterion grouping.

Subsequent analysis of the Quantified Self-Concept Inventory indicates that this instrument lacks validity when utilized on the present sample. A study of the item analysis of the Quantified Self-Concept Inventory indicates that the apparent significant differences in self-concept actually derive from the fact that 36 percent of the low girl responses, 29 percent of the high girl responses, 30 percent of the low boy responses, and 24 percent of the high boy responses could not even be scored. Thus the Q.S.C.I. was unable to adequately differentiate between the "criterion groups."

The supposition that girls would be significantly superior in achievement in kindergarten and in their perceptions of themselves than would boys was not confirmed by the results of the present study. These results contradict the findings that have been reported by other researchers, such as Dubin and Dubin (6), Davidson and Lang (5), and Fink (8), who based their conclusions on research conducted with older children.

Perhaps one explanation of the findings of the present study can be obtained by reporting Bledsoe's (2) study. He found significant differences in mean self-concepts of boys and girls at both the fourth grade and sixth grade levels, indicating that at these levels girls have greater self-esteem than boys. He hypothesized that the reason for this may be that the more frequent contacts with women teachers and with mothers (as compared with fathers) enables girls to develop a more satisfying self-concept at these developmental stages.

The findings reported in the present study seem clearly to confirm Bledsoe's hypothesis. It would appear that at the kindergarten level the factor of more female contact, contributing a derogatory effect on male self-concept and thus upon achievement, has not as yet begun to exhibit its effects. It can be said that this factor continues to operate and its derogatory effects on male self-concept and thus on achievement is measurable some years later in the developmental schema. This finding, if true, is of significant importance to educational and developmental psychology. It lends significant support to those who have been proposing that more male teachers be placed in the lower grades.

The results of the present investigation lent strong support to Brown's (3) cogent comments regarding the measurement of the self-concept at early developmental levels. He points out the considerable difficulties involved in reliably assessing the dimensions of self-concept among young children. He comments that young children exhibit a generally limited ability to clearly verbalize complex self feelings and perceptions. Another major source of difficulty in the assessment of self-concept among young children, according to Brown, stems from the devices and procedures on which we have come to rely. We have all too often tended to rely on the downward revisions of techniques originally developed to measure self-concept among adults. This has resulted in the utilization of procedures that are often of limited use with young children due, says Brown, to their dependence on the ability of the subject to explore his feelings about himself in depth and to verbally report the essence of these self feelings to an adult.

Perkins and Shannon, based upon the results of their 1965 study (14), had suggested that techniques other than verbal self-report approaches might be suitable for assessing self-perceptions, and also that the pictorial identification techniques with children had a novelty which quickly aroused interest and attention. The present study bears out their contentions.

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CONCEPTUAL FRAMES OF PARENTAL ATTITUDES OF FATHERS*[1]

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A. INTRODUCTION

Recent advances in the study of parent-child relations show an increasing awareness on the part of the psychologists and researchers to include the father along with the mother in such studies (e.g., 4, 5, 6, 9, etc.). Schaefer and Bell (10) developed earlier a mother's form of parental attitude research instrument (PARI) and later added a comparable form for fathers (11). While a great many researches have been reported using mother's form of PARI, relatively few studies have been done using father's PARI. Nichols (7) and Cline (2) have reported factor analytic studies of father's PARI. Schaefer (8) suggested that further replications using other sets of data will be useful in planning future research on parent behavior. It was the purpose of this study to test the replicability of factors [as derived through factor analysis in previous studies (2, 7)] of father's PARI, and thereby to delineate generalizable conceptual frames of parental attitudes of fathers. A second objective was to develop a reversed form of the questionnaire which, when combined with the first form, could control for acquiescence set.

B. METHOD

1. *Subjects*

Two hundred and sixty-nine male students, enrolled in the introductory psychology course at the University of Manitoba, voluntarily participated in this study. The *S*s were between the ages of 18 years to 22 years; the mean age was 18.9 years. The *S*s of this study were drawn from a cross-section of university departments. The largest number of *S*s were drawn from urban Manitoba, primarily the city of Winnipeg.

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2. *The Instrument and the Procedure*

The parental attitude instrument for fathers as developed by Schaefer and Bell (11) is a Likert-type attitude questionnaire. The original scale consisted of 30 scales of eight items each. A revised scale was made by selecting 20 scales of five items each. The selection of items and scales was based on item reliability and relevance (11). The revised questionnaire of 100 items was administered to the *S*s with standard instructions. The *S*s were asked to indicate their opinions on a four-point scale which ranged from strongly agree, mildly agree, to mildly disagree and strongly disagree. A second form of the questionnaire (Q.2) was administered to the same *S*s a week later.

The second form of the questionnaire (Q.2) consisted of reversed items from the Q.1. The item reversals were done by the present authors in order to control for response set biases or acquiescence set as discussed by Zuckermann (13). The two forms,[2] Q.1 and 2, were similar forms except that the wording of Q.2 items was the opposite of the corresponding Q.1 items. (If the subjects were logically consistent, agreement with a Q.1 item implied disagreement with the corresponding Q.2 item.)

C. RESULTS

Correlation matrices of 20 × 20 scale scores were calculated separately for Q.1 and Q.2. The matrices were factor analyzed by the principal axes method and rotated orthogonally through the Varimax solution. With the use of an eigen-value of 1.0 as the cut-off point, five factors in Q.1 and six factors in Q.2 were retained. Table 1 shows the proportion of variance accounted for before rotation.

D. DISCUSSION

1. *Factor Structure*

In this section the factors of Q.1 and Q.2 are described briefly, next an attempt is made to show the similarities and differences between factors of Qs.1 and 2, as well as Nichol's factor-analysis and that of Cline's (see Tables 2 and 3). To describe factors only in terms of those scales which have significantly high loadings, a cut-off point of ±.40 was taken as the lowest significant loading.

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[2] Revised forms of Qs. 1 and 2 can be obtained either directly from the authors, or from NAPS. Copies of unreversed and reversed forms of Father's PARI have been deposited with NAPS. Order Document No. 01019 from ASIS National Auxiliary Publication Service, c/o CCM Information Sciences, Inc., 22 West 34th Street, New York, New York 10001; remitting $2.00 for microfiche or $5.00 for photocopies.

TABLE 1
PROPORTION OF VARIANCE ACCOUNTED FOR BEFORE ROTATION PARI SCALES
(FATHER'S FORM)

Questionnaire	F_1	F_2	F_3	F_4	F_5	F_6	Cum. percent variance
Q. 1 (Unreversed Items)	24.05	12.54	7.74	6.27	5.55		56.15
Q. 2 (Reversed Items)	17.90	12.03	8.79	7.29	5.99	5.37	57.37

a. Questionnaire 1 factors: (unreversed items). F_{11}: Nine scales which compose the factor are Breaking the Will, Harsh Punishment, Deification of Parent, Exclusion of Outside Influence, Strictness, Suppression of Sexuality, Ascendancy of Husband, Suppression of Affection, and Change Orientation. F_{11} resembles closely Nichol's F_A (Authoritarian Control) and F_E (Firm Discipline). Therefore, F_{11} is called Authoritarian Discipline. This factor is also highly similar to Cline *et al.*'s F_I (Authoritarian Control) and F_V (Independence-Achievement Orientation).

F_{12}: Five scales describe F_{12}, these are Irresponsibility of Father, Irritabil-

TABLE 2
PARI UNREVERSED SCALES (FATHER'S FORM) QUESTIONNAIRE 1
ROTATED FACTOR MATRIX

		Factors				
	Scales	F_1	F_2	F_3	F_4	F_5
1	Encouraging Verbalization	.05	—.01	.11	—.06	.82
2	Fostering Dependency	—.17	.01	.31	.65	—.20
3	Breaking the Will	—.53	—.05	—.07	.54	—.05
4	Harsh Punishment	—.49	.18	—.44	.26	—.11
5	Deception	.00	.28	—.23	.75	.04
6	Marital Conflict	—.06	.51	—.33	.15	.19
7	Nonpunishment	.08	.02	.84	.06	.07
8	Irresponsibility of Father	.04	.72	.12	.13	.01
9	Suppression of Aggression	—.37	—.03	.54	.01	—.26
10	Deification of Parent	—.73	.02	.16	.11	—.09
11	Exclusion of Outside Influence	—.51	.12	.22	.42	—.42
12	Irritability	—.06	.74	.04	.07	.12
13	Strictness	—.67	.21	—.16	—.10	—.24
14	Suppression of Sexuality	—.47	.05	.22	.19	—.49
15	Ascendancy of Husband	—.64	.28	—.16	.09	.00
16	Inconsiderateness of Wife	—.20	.69	—.03	.05	—.13
17	Complaint of Ascendancy of Wife	—.26	.66	—.11	—.09	—.10
18	Suppression of Affection	—.62	.07	.00	.00	.09
19	Change Orientation	—.57	.05	.12	.20	.02
20	Forcing Independence	—.39	.27	—.22	—.01	.48

TABLE 3
PARI REVERSED SCALES (FATHER'S FORM) QUESTIONNAIRE 2
ROTATED FACTOR MATRIX

	Scale	Factors					
		F_1	F_2	F_3	F_4	F_5	F_6
1	Encouraging Verbalization	.69	.20	—.11	.15	—.05	.09
2	Fostering Dependency	—.05	.07	.04	—.01	.77	—.09
3	Breaking the Will	—.22	—.74	.11	.03	.21	.02
4	Harsh Punishment	—.05	—.82	.11	.09	—.03	.06
5	Deception	—.22	—.12	.58	.05	.07	.05
6	Marital Conflict	.44	—.01	.46	.17	—.08	—.28
7	Nonpunishment	.26	.68	—.04	.00	.20	.18
8	Irresponsibility of Father	.12	—.02	.54	—.26	.34	.33
9	Suppression of Aggression	—.31	.08	—.22	.09	.58	.05
10	Deification of Parent	—.50	—.17	.08	.45	.10	—.09
11	Exclusion of Outside Influence	—.71	—.09	.19	.11	.27	—.24
12	Irritability	.00	—.05	.76	—.05	—.09	—.07
13	Strictness	.08	—.58	—.12	.45	—.02	.08
14	Suppression of Sexuality	—.67	—.09	—.05	.05	.14	.17
15	Ascendancy of Husband	—.00	—.25	.09	.65	—.07	.09
16	Inconsiderateness of Wife	.05	.03	—.12	.77	.03	.02
17	Complaint of Ascendancy of Wife	—.19	.09	.43	.44	—.18	.23
18	Suppression of Affection	—.28	—.32	.00	—.02	.39	.44
19	Change Orientation	—.13	—.07	.07	—.09	.69	—.08
20	Forcing Independence	.11	.05	.05	.19	—.23	.76

ity, Inconsiderateness of Wife, Complaint of Ascendancy of Wife, and Marital Conflict. The factor described is that of Hostile Rejection and is closely similar to Nichol's F_B (Marital Conflict), therefore F_{12} is also labelled as Marital Conflict. The factor is highly similar to Cline *et al.*'s F_{III} (Hostility-Rejection) and F_{VI} (Male Dominance), because of the shared common scales.

F_{13}: There are only three scales which describe this factor. The scales are Non-Punishment, Suppression of Aggression, and Harsh Punishment. Since the factor is similar to Nichol's F_D, it is called Punishment Orientation. It is the same factor as Non-Punishment (F_{IV}) in Cline's analysis.

F_{14} is described best by four scales—Fostering Dependency, Breaking the Will, Deception, and Exclusion of Outside Influence. The factor descriptive label is borrowed from Schaefer and Bell (8) to call it Suppression and Interpersonal Distance. F_{14} resembles somewhat Nichol's F_A and F_B; and resembles closely Cline *et al.*'s F_I (Authoritarian Control). Cline's F_I thus comprises scales which compose F_{11} and F_{14}.

F_{15} is composed of 4 scales—Encouraging Verbalization, Forcing Independence, Suppression of Sexuality, and Exclusion of Outside Influence. The last two scales are negatively correlated and the first two scales are positively correlated with the factor. F_{15} is highly similar to Nichol's F_O and somewhat similar to Cline *et al.*'s F_{11}, therefore it is labelled as Democratic Attitude. Thus four factors—i.e., Authoritarian Control, Marital Conflict, Democratic Attitudes, and Punishment Orientation—are common across three analyses compared so far.

b. Questionnaire 2 factors: (reversed items). F_{21}: The five scales which compose this factor are Encouraging Verbalization, Marital Conflict, Deification of Parent, Exclusion of Outside Influences, and Suppression of Sexuality. The last three scales are negatively correlated, while Encouraging Verbalization is positively correlated with the factor. Therefore, the factor is labelled as Democratic Attitudes, and is highly similar to F_{15}. This factor overlaps somewhat with the domain of F_{11}.

F_{22}: Four scales which describe this factor are Breaking the Will, Harsh Punishment, Non-Punishment, and Strictness. The factor overlaps the domain of F_{13} and F_{11}. Since the factor description is basically in terms of punishment content of both factors, F_{11} and F_{13}, therefore, it was decided to label it as Punishment Orientation.

F_{23} is composed of the following five scales—Irresponsibility of Father, Irritability, Deception, Marital Conflict, and Complaint of Ascendancy of Wife. The factor description is one of Hostile Rejection, and is highly similar to F_{12}. The factor is labelled Marital Conflict.

F_{24} consists of five scales—Deification of Parents, Strictness, Ascendancy of Husband, Inconsiderateness of Wife, and Complaint of Ascendancy of Wife. F_{24} also overlaps the domain of F_{11} and F_{12}. The first three scales are common with F_{11} and the last two scales are common with F_{12}. In terms of factor description, F_{24} resembles more closely F_{11} than F_{12}, and therefore is labelled Authoritarian Control.

F_{25} is described by three scales—Fostering Dependency, Suppression of Aggression, and Change Orientation. F_{25} is somewhat similar to F_{13} and F_{11}. Nevertheless, the factor seemed to be described well by neither of these two factors. To distinguish this factor from other factors, it was labelled Aggressiveness.

F_{26} is more or less uniquely constituted by two scales—Forcing Independence and Suppression of Affection. The factor does not show close similarity to any of the factors of Q.1, and seems to be a unique factor, and therefore not labelled specifically.

2. *Factorial Similarity*

In order to assess similarity between factors of the three factor matrices, it is first of all necessary to ascertain that the factors within each of the matrices are independent. The latter assessment is made through calculations of factor similarities within each of the matrices separately. Coefficients of similarity were computed by using Wrigley and Neuhaus formula (3, pp. 257-258). Table 4 indicates that the factors within factor matrices of Q.1 and Q.2 are independent within their respective matrix. A low intercorrelation is interpreted to mean factorial independence—i.e., orthogonality of factors. The factors within Nichol's factor analysis, however, indicate high positive intercorrelation between F_A and F_B (.54), F_A and F_E (.66), F_B and F_E (.57), and F_C and F_D (.57). To this extent the factors within Nichol's factor analysis are not independent but overlapping and oblique. Such a situation occurs whenever there are a few items which are common between two or more factors. Nichol has discussed this aspect in his paper.

Cline *et al.*'s factors are not entirely independent. F_I tends to be correlated positively with F_{II} (.37), F_V (.54), F_{VI} (.55) and negatively with F_{VII} (—.46). Similarly F_V is positively correlated with F_{VI} (.60) and negatively with F_{VII} (—.46). F_{VI} and F_{VII} are negatively correlated (—.54). F_{II} is also somewhat negatively correlated with F_{VII} (—.39). The intrafactor similarities within Cline *et al.*'s factors are sufficiently high to indicate that these factors have overlapping domains. The latter accordingly tend to influence comparison of factor similarities between two different matrices.

The higher the intercorrelations between factors of two or more factor matrices, the greater is the similarity, and *vice versa*. The greater the similarity between factors of two or more factor matrices, the greater is the replicability of the factors. The greater the frequency of factor/factors replicability in diverse samples, the greater is the generalizability of the conceptual frames involved. Table 5 shows that F_{11} is highly similar to F_A and F_E (—.87 and —.83); F_{12} is highly similar to F_B and somewhat similar to F_E (.95 and .54 respectively); F_{13} is closely similar to F_D (—.74); F_{15} resembles closely F_C (.72); and F_{14} is somewhat similar to F_A and F_B (.66 and .49 respectively). Thus, on a quantitative basis also there are four factors of Q.1 which are highly similar to four factors of Nichol's. Since F_A, F_B, and F_E are closely similar within Nichol's factor matrix, therefore, these overlapping factors tend to influence also the factorial similarities between F_{11} and F_A and F_E, and between F_{12} and F_B and F_E. Considerable overlap between F_A and F_B also influence the coefficients of similarity with F_{14}. F_A indicates the control dimension and F_E the firm discipline dimension of Authoritarianism. These two aspects of authoritarianism are combined in F_{11} and as such is labelled Authoritarian Discipline. However, the authoritarian control-discipline aspect is differentiated in F_{14} from the suppressive aspect of authoritarianism. No doubt F_{14} labelled as Suppression shares some common aspects

TABLE 4

COEFFICIENTS OF SIMILARITY WITHIN FACTORS OF PARI SCALES (FATHER'S FORM)

	Questionnaire 1 Factor analysis (Unreversed items)			
	F_1	F_2	F_3	F_4
F_2	—33			
F_3	01	—17		
F_4	—41	24	05	
F_5	30	02	—20	—25

	Questionnaire 2 Factor analysis (Reversed items)				
	F_1	F_2	F_3	F_4	F_5
F_2	28				
F_3	—11	—15			
F_4	—07	—24	04		
F_5	—28	—06	02	—10	
F_6	15	—03	05	13	01

	Nichol's Factor analysis (Unreversed items)[1]			
	F_A	F_B	F_C	F_D
F_B	54			
F_C	—30	—12		
F_D	—23	—07	57	
F_E	66	57	—14	08

	Cline *et al's* Factor analysis (Unreversed Scales)[2]					
	F_I	F_{II}	F_{III}	F_{IV}	F_V	F_{VI}
F_{II}	37					
F_{III}	21	24				
F_{IV}	06	26	04			
F_V	54	25	27	10		
F_{VI}	55	26	30	—07	60	
F_{VII}	—46	—39	—23	06	—46	—54

Note: Decimal points have been omitted (i.e., —.33).

[1] Coefficients of similarities were computed only for those 20 scales (from a total of 25 scales) which were also used in Q.1.

[2] Coefficients of similarity were computed only for those 20 scales (from a total of 30 scales) which were also used in Q.1.

with F_A (authoritarian control) and F_B (Marital Conflict). F_A further tends to correlate fairly highly with F_{14} and F_{15} besides correlating with F_{11}. It seems then that the characteristics of F_A (Authoritarian Control) were differentiated further in F_{14} (Suppression) and F_{15} (the reverse of Democratic Attitudes). This differentiation may be due to the fact that the *S*s in the two samples tend to look upon Authoritarianism in different dimensions: i.e., control, discipline, suppression, and lack of democratic attitudes, etc. If this is so, then the items of the same scales may be interpreted differently by different *S*s. It is quite likely that the college males may have a well-differentiated concept of authoritarianism, and consequently tend to respond in the context of the varieties of the associated dimensions of authoritarianism. Similarly the Marital Conflict factor may be differentiated by the college males not only in its Hostility-Rejection dimension (F_{12}), but also in its suppressive aspect associated with hostile conflicts (F_{14}). Comparison of factors between Q.1 and Nichol's factor matrices offers evidence in favour of a high degree of factor replicability.

The interfactor comparisons between Q.1 and Cline *et al.*'s factors reveal the following similarities. F_{11} is highly correlated to F_I (.73) and F_V (.76) and to some extent with F_{VI} (.57). Thus the F_{11}, Authoritarian Discipline is described by scales which are in common with the scales of F_I, Authoritarian Control and F_V, Independence-Achievement Orientation, and F_{VI}, Male Dominance. It is basically the control dimension which is described somewhat differently in F_I, F_V, and F_{VI}. F_{12} is highly similar to F_{III} (—.73) and F_{VI} (—.77). The latter two factors of Cline's analysis are labelled as Hostility-Rejection and Male Dominance, respectively. Since these two factors are composed of a number of scales which also compose F_{12}, therefore the factors are highly similar. F_{13} is highly correlated with F_{IV} (.75) and somewhat with F_{III} (.40). F_{14} is correlated to F_I (—.73) and somewhat to F_{III} (—.45). Lastly, F_{15} is positively correlated to F_{II} (.59) and F_I (.48) and somewhat negatively to F_{VII} (—.46). Here again the four factors which are replicated are Authoritarian Control, Democratic Attitudes, Hostility-Rejection, and Non-Punishment.

Matrices of coefficients of similarity between the three factor matrices—i.e., Q.1, Nichol's and Cline *et al.*'s factors—indicate that the patterns of "high" (larger than ±.40) and "low" coefficients similarity between Q.1 and Nichol's on the one hand, and Q.1 and Cline's on the other hand, are almost identical. Therefore, certain factors of Nichol's seem to be highly similar to factors of Cline when one uses patterns of similarity to Q.1 as the criterion (F_A *vs.* F_I, F_B *vs.* F_{III}, F_C *vs.* F_{II}, F_D *vs.* F_{IV}, F_E *vs.* F_{VI}). The close similarity of factor structures among the three samples of *S*s who have been compared here, indicates that the differences in the marital status, as well as the amount of experience with the father-role, is not a crucial variable for differentiating paternal attitudes toward child-rearing on PARI scales. This is not necessarily so in the case of females, where the amount of experience with mother-role tends to influence their attitudes and simpler factor structures of PARI scales are obtained (e.g., 8); or the factor-structures of unmarried women are more complex (e.g., 9, 12). The differences may probably be attributed to the greater degrees of involvement and intimacy that are required in a close mother-child interaction than are necessary in the case of father-child interaction. Consequently, unmarried females would tend to describe maternal-role and attitudes in terms of their differentiated perception and cognition of others in this role, whereas experienced mothers would likely describe their personal feelings, emotions, and attitudes in interactions with their children. As far as males are concerned, whether they are married and experienced fathers or not tends to make little difference because of the fact that in either case males are much less involved emotionally in the day-to-day care of children, and therefore tend to describe their experiences in terms of their perception and cognition in their own life, as well as in that of others.

The coefficients of similarity calculated between factors of Q.1 and Q.2 are somewhat lower than that between Q.1 and Nichol's factor matrix (see Table 5). The lower intercorrelations may partly be attributed to the reversed directions of items in Q.2, as well as to the interpretations of reversed items by the *S*s. There is also the possibility of response set bias in the reverse direction. One of the purposes of this paper was to study the effects of reversed items on response sets (i.e., acquiescence and opposition sets) of the *S*s. If there was any definite bias on the *S*s' responses on the two questionnaires in opposite directions, then this might have resulted in two highly dissimilar factor matrices. As is evident from Table 5, this is not so. However, there seems to be some evidence that the direction of items does tend to influence responses on Q.2 somewhat differently from Q.1. F_{11} tends to be somewhat similar to F_{21}, F_{22}, and F_{24}. It appears that item reversals tend to result in differentiation of a general factor of Authoritarian Discipline into three aspects: i.e., Punishment, High Control, and Dominance. Similarly F_{12} while highly similar to F_{23} is also somewhat similar to F_{24}. Thus the Marital Conflict factor also gets differentiated in Q.2 into two aspects: i.e., Hostility-Rejection, and Assertion of Male Dominance. F_{13} is somewhat similar to two factors F_{22} and F_{25}. The factor of Punishment-Orientation is differentiated thereby into its punishment and aggressiveness aspects. F_{15} is highly similar to F_{21}. The F_{14} and F_{26} do not appear to be correlated to any of the other factors. Thus, here again four factors in the two questionnaire matrices are also similar. As such, Q.2 in reversed form is comparable to Q.1 in unreversed form. Following Zuckermann's (13) suggestion, the two forms may then be combined to control for acquiescence set. Since the factor structures of Q.1 and Q.2, as well as Nichol's and Cline's factor matrices, are essentially similar, it may be concluded that reduction in the number of items in Q.1 and Q.2 did not reduce the factorial validity of the Father's PARI scales. Compared with the original versions of the Father's PARI the reduced forms provide essentially the same information in less time.

E. SUMMARY

Two forms of Father's PARI scales—i.e., Q.1 (unreversed items) and Q.2 (reversed items)—were administered to 269 first year college male students. Q.1 was adapted from original Father's form of PARI, and reduced to 20 scales of five items each. Q.2 items were phrased in reverse order to that of Q.1. Five factors for Q.1 and six factors for Q.2 were obtained through factor analyses. Four factors in Q.1 were replications of four factors in Nichol's and Cline *et al.*'s reported studies. The four replicated factors were Authoritarian Control, Democratic Attitude, Hostility-Rejection, and Punishment Orientation. The reduced scales of PARI can therefore be used just as adequately as the original long scales and require less time. PARI scales were shown to be stable even under reversed item conditions. Q.1 and Q.2 can be combined to control for acquiescence set.

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CONCEPTUALIZATION OF MATERNAL BEHAVIOR*[1]

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A. INTRODUCTION

Schaefer and Bell (2, 9, 10) developed a conceptual model of maternal behavior which consisted of an inventory study of attitudes toward child rearing. The Fels Parent Behavior Rating Scales reported by Baldwin, Kalhorn, and Breese (1), as well as the ratings of maternal behavior reported by Sanford, Adkins, Miller, and Cobb (6), are further conceptualizations of maternal behavior in rating forms. Roe (5) developed another model from a clinical analysis of the universe of parent behavior. Slater (11) derived another model from retrospective reports of parent behavior. Schaefer (7) has reported that these conceptualizations, as well as a few other models of maternal behavior, seem to converge on three major factors: Authoritarian Control, Hostility-Rejection, and Democratic Attitudes. Zuckerman, Ribback, Monashkin, and Norton's (13) normative data on Schaefer and Bell's Parental Attitude Research Instrument (PARI) also demonstrated the viability of the three major factors. Schaefer (7) has reported that the factorial structures of PARI scales are dependent on the roles a woman has had in parent-child relationships, the experienced mothers tend to reveal a simpler pattern (i.e., fewer factors) than less experienced women. Zuckerman (12) has also indicated that the PARI items (Mother's Form) are susceptible to acquiescence set, and proposed item reversals as a means of counter-balancing. The present study had three objectives: (*a*) to test the replicability of the three major factors reported for PARI scales by Schaefer and Bell, as well as by Zuckerman *et al.*, (*b*) to test whether the less experienced women tend to reveal more complex patterns of factorial structures than do experienced mothers, and (*c*) to investigate the changes in factor structure due to reversals in items of the PARI scales (Mother's form). Is the factorial validity of the PARI scales changed as a result of changes in the direction of items?

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B. METHOD

1. *Subjects*

Two hundred and ninety-three female college students participated in the study. The *S*s were enrolled in an introductory psychology course at the University of Manitoba. The *S*s in this investigation represented a variety of college faculties and departments. The majority of the *S*s came from urban areas of Manitoba, mostly from Winnipeg. The age range of the *S*s was from 17 years to 22 years, with a mean age of 18.5 years. The *S*s were heterogeneous with respect to ethnic background and religion.

2. *The Instrument and Procedure*

PARI is an attitude questionnaire which consists of 23 scales of five items each, in the Mother's Form. The *S*s' opinions are elicited by asking them to circle one of the four alternatives for each item. The four alternatives are Strongly Agree (A), Mildly Agree (a), Mildly Disagree (d) and Strongly Disagree (D). Two forms of the PARI scales were used, questionnaire one (Q.1) contained unreversed items, and questionnaire two (Q.2) contained reversed items which were borrowed from Zuckerman's (12) list of reversed items. The second questionnaire contained 20 of the 23 scales. The *S*s were administered the first questionnaire in groups with the standard instructions for responding. A week later the same *S*s responded on the second questionnaire.

C. RESULTS

Two correlation matrices of 23 × 23 scales and 20 × 20 scales were calculated for the first and second questionnaires respectively. The two correlation matrices were factor analyzed by the principal axes method and rotated orthogonally through the varimax solution. Eigen-value of 1.0 was used as the cut-off point to stop rotations. Five factors were obtained for Q.1 and six factors for Q.2. The proportion of variance accounted for before rotation is given in Table 1. Tables 2 and 3 present the Rotated factor matrix for Qs.1 and 2, respectively.

D. DISCUSSION

1. *Factor Structure*

The five factors of Q.1 and six factors of Q.2 are described briefly in this section. In both cases the 5 to 6 factors account for approximately 53.5 per cent of the total variance before rotation. Only the first two factors in both questionnaires can be called common factors. The first two factors in Q.1 ac-

TABLE 1
PROPORTION OF VARIANCE ACCOUNTED FOR BEFORE ROTATION OF PARI SCALES (MOTHER'S FORM)

Questionnaire	F_1	F_2	F_3	F_4	F_5	F_6	Cumulative percent variance
Q. 1 (Unreversed items)	26.44	10.04	7.12	5.09	4.69		53.38
Q. 2 (Reversed items)	17.59	11.09	7.28	6.50	5.96	5.28	53.70

count for approximately 36.5 percent of total variance, whereas in Q.2 the first two factors account for 28.7 percent of variance. To this extent Schaefer's (7) findings are corroborated in the present study that there are two major factors of maternal behavior conceptualized in the PARI scales. The rest of the factors are specific factors, but they are described here along with common factors in order to delineate the characteristics of the factor structures as obtained in the analyses. Factors of Q.1 are numbered as F_{11}, F_{12},

TABLE 2
PARI UNREVERSED SCALES (MOTHER'S FORM)
Varimax Rotated Factor Matrix

Scales	F_1	F_2	F_3	F_4	F_5
1. Encouraging Verbalization	—.23	.15	.72	—.17	—.02
2. Fostering Dependency	.48	.00	—.08	.30	—.10
3. Seclusion of the Mother	.35	—.07	.22	.50	—.23
4. Breaking the Will	.54	.17	—.03	.27	—.31
5. Martyrdom	.40	.37	—.12	.47	—.14
6. Fear of Harming the Baby	.22	.41	.20	.15	—.22
7. Marital Conflict	.12	.62	.16	—.21	—.18
8. Strictness	.69	.21	—.00	—.07	—.12
9. Irritability	.01	.84	.00	—.11	—.07
10. Excluding Outside Influences	.69	.01	—.08	.38	—.11
11. Deification	.72	.08	.03	.35	—.16
12. Suppression of Aggression	.16	—.00	.09	.70	—.08
13. Rejection of the Homemaking Role	—.07	.71	—.14	.33	.12
14. Equalitarianism	—.48	.13	.55	.03	—.22
15. Approval of Activity	.27	.14	.15	—.03	—.66
16. Avoidance of Communication	.18	.10	—.36	.16	—.53
17. Inconsiderateness of the Husband	.06	.50	—.14	.49	—.23
18. Suppression of Sexuality	.24	.06	—.23	.64	—.18
19. Ascendancy of the Mother	.22	.13	—.11	.36	—.51
20. Intrusiveness	.42	—.04	.02	.41	—.28
21. Comradeship and sharing	.25	—.07	.68	.13	.07
22. Acceleration of Development	.00	.07	.08	.24	—.67
23. Dependency of the Mother	.23	.44	.16	.40	—.16

TABLE 3
PARI REVERSED SCALES (MOTHER'S FORM)
Varimax Rotated Factor Matrix

Scales	F_1	F_2	F_3	F_4	F_5	F_6
1. Fostering Dependency	.59	—.15	—.01	.02	.14	.27
2. Seclusion of the Mother	.70	.06	.00	—.13	.02	.08
3. Breaking the Will	.47	.14	.55	.21	—.13	—.16
4. Martyrdom	.46	.40	.06	—.01	.12	—.17
5. Fear of Harming the Baby	.25	.18	—.03	.09	.69	—.19
6. Marital Conflict	—.09	.58	.11	—.09	.19	—.27
7. Strictness	.09	.02	.72	.16	.08	—.13
8. Irritability	—.11	.73	.12	—.04	.04	—.09
9. Excluding Outside Influences	.45	.17	.32	.24	—.07	.40
10. Deification	.44	—.15	.18	.32	.21	.02
11. Suppression of Aggression	.19	—.09	—.08	.02	—.04	.71
12. Rejection of the Homemaking Role	.13	.69	—.16	—.00	—.00	.23
13. Approval of Activity	—.10	.06	.13	.77	—.01	.20
14. Avoidance of Communication	.45	.27	.06	.14	—.53	.02
15. Inconsiderateness of the Husband	.08	.62	—.21	.33	—.01	.06
16. Suppression of Sexuality	.60	—.01	—.09	.24	—.08	.07
17. Ascendancy of the Mother	.17	.16	—.55	.20	.08	—.16
18. Intrusiveness	.40	—.05	.14	.53	.09	.24
19. Acceleration of Development	.13	.03	—.09	.68	—.01	—.26
20. Dependency of the Mother	.01	.32	.03	.03	.58	.42

F_{13}, F_{14}, and F_{15} to indicate these factors belong to the factor structure of Q.1. Similar distinctions are made for factors of Q.2 by numbering the factors as F_{21}, F_{22}, F_{23}, F_{24}, and F_{25}. Factor loadings of ±.40 are considered significant for factor descriptions.

a. Questionnaire One: F_{11} is a description of Control dimension in parent-child interaction. The factor is best described by eight scales—Deification, Exclusion of Outside Influences, Strictness, Breaking the Will, Fostering Dependency, Lack of Equalitarianism, Martyrdom, and Intrusiveness. The first three scales show the highest loadings and to that extent describe the factor as one of Firm Control or Hostile Control. This factor can be differentiated from F_{14} which also describes the control dimension but tends to emphasize more the psychological control aspect. The factor is highly similar to Zuckerman *et al.*'s factor of Authoritarian Control. In Schaefer and Bell's first analysis (unmarried nurses) Factors $_{\text{III}}$ and $_{\text{IV}}$ each share three scales in common with F_{11} and to that extent are closely similar. Schaefer's second analysis (multiparae) shows six scales are in common between his factor one and F_{11}, therefore the two factors resemble each other closely.

F_{12} is the second major factor and can be described in terms of the following variables—Irritability, Rejecting Homemaking Role, Marital Conflict, Inconsiderateness of Husband, Dependency of Mother, and Fear of Harming the Baby. This factor is highly similar to Zuckerman *et al.*'s factor of Hostility-Rejection, as well as to Schaefer's factor of Approval of Expression of Hostility (multiparae analysis), or alternately the factor of Hostile Rejection of Homemaking Role (unmarried nurses factor-analysis).

F_{13} is described by three variables—Encouraging Verbalization, Comradeship and Sharing, as well as Equalitarianism. The factor corresponds closely to Zuckerman's factor "Democratic Attitudes" and to Schaefer's factor "Approval of Positive Attitudes Toward Child-Rearing." The first three factors of Schaefer's (7) data on multiparae, as well as the three factors of Zuckerman *et al.*'s normative data are also replicated in this study. Therefore the three factors are highly replicable in heterogeneous samples.

F_{14} is a description of the psychological aspect of the Control dimension. The control is exercised through arousal of feelings of guilt and suppression of threatening incidents. The scales which compose the factor are Suppression of Aggression, Suppression of Sexuality, Seclusion of Mother, Inconsiderateness of Husband, Martyrdom, Intrusiveness, and Dependency of Mother. Since the factor is also a control dimension, it is labelled here as Psychological Control to differentiate it from F_{11} which is descriptive of Firm or Hostile Control. The factor resembles closely Zuckerman *et al.*'s Authoritarian Control factor, as well as the factor (IV) of Over-Possessiveness in Schaefer and Bell's first analysis (unmarried nurses).

F_{15} consists of four scales—Acceleration of Development, Approval of Activity, Avoidance of Communication, and Ascendancy of Mother. The scales seem to describe the opposite of control: i.e., encouragement, divergence, and emancipation. The factor may therefore be labelled as Psychological Autonomy. This factor appears as the opposite pole to Zuckerman *et al.*'s Authoritarian-Control factor, and is highly negatively correlated with the latter.

The factor structure of Q.1 seems to fit well into Schaefer's (8) three-dimensional model of parent behavior.

b. Questionnaire Two: F_{21} is described by nine variables which combine some of Hostile Control variables of F_{11} and Psychological Control variables of F_{15}. The factor is highly similar to the Authoritarian-Control factor in Zuckerman *et al.*'s normative data. The nine scales with significant loadings are, Seclusion of Mother, Suppression of Sexuality, Fostering Dependency, Breaking the Will, Martyrdom, Exclusion of Outside Influence, Deification, Avoidance of Communication, and Intrusiveness. F_{21} correlates positively with F_{11} and F_{14}, and negatively with F_{15}.

F_{22} is the Hostility-Rejection factor as described by Zuckerman *et al.*, and is highly similar not only to Zuckerman's factor, but also to F_{12}. The factor is described by five scales—Irritability, Rejecting Homemaking Role, Inconsiderateness of Husband, Marital Conflict, and Martyrdom.

F_{23} may be labeled as Punishment Orientation, because the three scales which describe the factor are Strictness, Breaking the Will, and Ascendancy of Mother. Punishment may also be used as a means to control behavior, and therefore this factor also tends to describe a slightly different aspect of control dimension.

F_{24} can be called "Excessive Demand for Striving" which is achieved through positive means of approval and encouragement, and negatively through a certain degree of intrusiveness. The three scales describing the factor are Approval of Activity, Acceleration of Development, and Intrusiveness. F_{24} resembles highly F_{15} which is the Factor of Psychological Autonomy.

F_{25} is composed of three scales—Fear of Harming the Baby, Dependency of Mother, and Avoidance of Communication. It seems to be a factor of Hostile Neglect in mother-child relations.

F_{26} describes control through suppression, and seems to be only another form of control. The scales describing the factor are Suppression of Aggression, Dependency of Mother, and Exclusion of Outside Influences.

2. *Factorial Similarity*

Quantitative estimates of factorial similarity substantiate the conclusions so far reached on a qualitative comparison of factors. In Table 4 the intrafactor similarities are shown. Coefficients of similarities were computed by using Wrigley and Neuhaus formula (4, pp. 257-258). Low intercorrelations within factors of a matrix tend to indicate that the factors are independent. The factors within Zuckerman *et al.*'s data are independent and so are the factors within Q.2, with only one exception. In Q.1, however, there is a correlation between F_{11} and F_{14} (.61), as well as between F_{11} and F_{15} (—.47). Also the F_{14} and F_{15} are correlated (—.50) negatively. There is a slight correlation between F_{11} and F_{14} (—.35). Since F_{11} is correlated with three other factors, this tends to influence the coefficients of similarity between factors of two different matrices. Similarly, since factors F_{14} and F_{15}, besides F_{12} and F_{15} are related, these would have further bearings on interfactor similarities. Table 4 shows that the five factors in Schaefer and Bell's factor analysis, are relatively independent with one exception. Factors III and IV are correlated (.52) and this would influence the interfactor similarities between matrices.

The interfactor similarities between Zuckerman *et al.*'s and Q.1 matrices,

TABLE 5

COEFFICIENTS OF SIMILARITY BETWEEN FACTORS OF PARI SCALES (FATHER'S FORM)

Questionnaire One (Unreversed Scales)	Schludermann and Schludermann Factor analysis Questionnaire Two (Reversed Scales-Schludermann)						Nichol's Factor analysis (Unreversed Scales)[1]					Cline *et al.'s* **Factor analysis**[2]						
	F_1	F_2	F_3	F_4	F_5	F_6	F_A	F_B	F_C	F_D	F_E	F_I	F_{II}	F_{III}	F_{IV}	F_V	F_{VI}	F_{VII}
Factor_1	54	62	—14	—59	—43	—28	—87	—43	06	—07	—83	73	32	13	25	76	57	—33
Factor_2	02	—14	75	49	02	28	37	95	—02	00	54	—33	—24	—73	13	—40	—77	29
Factor_3	—17	57	—23	—15	56	—01	28	—09	—17	—74	—26	—17	—01	40	75	10	—02	13
Factor_4	—39	—35	47	08	—07	—08	66	49	—35	—09	31	—73	—39	—45	—00	—16	—21	38
Factor_5	76	26	07	—09	—33	30	—47	—02	72	36	16	48	59	—27	26	12	34	—46

Note: Decimal points have been omitted (i.e., .54).

[1] Coefficients of similarity were computed only for those 20 scales which were also used in Q.1.

[2] Coefficients of similarity were computed only for those 20 scales (from a total of 30 scales) which were also used in Q.1.

TABLE 4

COEFFICIENTS OF SIMILARITY WITHIN FACTORS OF PARI SCALES (MOTHER'S FORM)

	Questionnaire 1 Factor analysis (Unreversed items)			
	F_1	F_2	F_3	F_4
F_2	.23			
F_3	—.13	.05		
F_4	.61	.29	—.10	
F_5	—.47	—.35	—.03	—.50

	Questionnaire 2 Factor analysis (Reversed items)				
	F_1	F_2	F_3	F_4	F_5
F_2	.16				
F_3	.21	—.00			
F_4	.37	.13	.17		
F_5	.04	.17	—.02	.03	
F_6	.25	—.05	—.02	.12	.02

	Zuckerman *et al.*'s Factor analysis (Unreversed items)	
	F_A	F_B
F_B	.05	
F_C	—.00	.24

	Schaefer and Bell's Factor analysis (Unreversed items)[1] (Unmarried nurses sample)			
	F_I	F_{II}	F_{III}	F_{IV}
F_{II}	—.27			
F_{III}	—.21	.23		
F_{IV}	.15	—.01	.16	
F_V	.28	.16	.52	—.05

---

[1] Coefficients of similarities were computed for only those 19 scales (from a total of 24 scales) which were also used in Q.1.

TABLE 5

COEFFICIENTS OF SIMILARITY BETWEEN FACTORS OF PARI SCALES (MOTHER'S FORM IV)

	Schludermann and Schludermann Factor analysis						Zuckerman's Factor analysis			Schaefer and Bell's Factor analysis[1]				
Questionnaire One (Unreversed scales)	Questionnaire Two Zuckerman et al.'s (Reversed scales)						Zuckerman's Normative Data (Unreversed scales)			(Unreversed scales) (Unmarried nurses sample)				
	F_1	F_2	F_3	F_4	F_5	F_6	F_A	F_B	F_C	F_I	F_{II}	F_{III}	F_{IV}	F_V
Factor$_1$	.79	.18	.56	.52	.24	.24	.80	—.17	—.16	.13	—.01	.70	.43	.80
Factor$_2$	.17	.94	.09	.20	.39	—.04	.50	.85	.18	—.03	.86	.37	.07	.32
Factor$_3$	—.26	—.16	.12	—.03	.61	.01	—.04	.06	.87	—.81	.26	.07	—.06	—.06
Factor$_4$	.82	.29	—.07	.45	.16	.51	.83	—.10	—.16	.38	—.02	.37	.79	.48
Factor$_5$	—.52	—.32	—.07	—.82	—.04	.01	—.80	—.02	—.16	—.20	—.21	—.64	—.30	—.56

[1] Coefficients of similarity were computed only for those 19 scales which were also used in Q.1.

show that the first three factors of Q.1 are highly similar to Zuckerman's factors. The comparisons reveal that Zuckerman's F_A is a bipolar factor with high positive loadings on F_{11} and F_{14}, and equally high negative loading on F_{15}. As described earlier, F_{11}, F_{14} describe the Firm Control and Psychological Control dimension respectively of maternal control, the bipolar end of the dimension is Psychological Autonomy. The F_{12} which is the Hostility-Rejection factor is highly similar to F_B. Because of the fact that F_{12} contains scales like Fear of Harming the Baby, Marital Conflict, Rejection of Homemaking Role, Inconsiderateness of Husband, and Dependency of Mother, which are part of the Authoritarian Control dimension (F_A) in Zuckerman's analysis, therefore, F_{12} also tends to be somewhat similar to F_A. The Hostility-Rejection dimension in Zuckerman's analysis (F_B) is defined mainly by two scales—i.e., Irritability and Rejection of the Homemaking Role—these two scales also compose F_{12}. The third dimension of maternal control which emerges in Zuckerman's analysis (F_C) as Democratic Attitude is identical to Schaefer and Bell's analysis (F_{III})—Positive Attitudes toward Child-Rearing—and is also highly similar to F_{13}. The interfactor comparisons between Zuckerman's analysis and Q.1 tend to establish the fact that the three factors reported by Zuckerman, as well as by Schaefer and Bell, are highly replicable.

The interfactor comparisons were made between Q.1 and Schaefer and Bell's (unmarried nurses sample) factors because it was considered appropriate to compare factor structures of two comparable samples: i.e., unmarried students' groups, and secondly, because it was one of the intentions of this paper to test the statement made by Schaefer (7) that the factor structures of PARI scales are dependent on the roles a woman has had in parent-child relationships and that the experienced mothers reveal a simpler pattern than the inexperienced women. There are five factors in each of the factor matrices of Q.1 and Schaefer and Bell's analysis. Quantitative estimates bear out the qualitative similarities. F_{11} is highly similar to F_{III} and F_V (.70 and .80 respectively) because of shared common scales among them. F_{12} is almost identical (a coefficient of .86) to F_{II}. F_{13} is highly negatively correlated (—.81) to F_I as it may be expected that Democratic Attitudes (F_{13}) would be opposite of Suppression and Interpersonal Distance (F_{III}). F_{14}, Psychological Control is closely correlated (.79) to F_{IV}, Over-Possessiveness, since the emphasis in both factors is control through feelings of guilt and fear. There is a certain degree of overlap between F_{14} and F_V also. F_{15}, Psychological Autonomy is negatively correlated with F_{III}, Over-Possessiveness, and F_V, Harsh Punitive Control. Factors III and V are positively correlated, therefore they appear together as the opposite extreme of Psychological Autonomy. The two factor structures are very similar, and tend to corroborate

Schaefer's statement that the factor structures of PARI scales are dependent on the roles a woman has had in parent-child relationships. The PARI factor structures in females is not so much a function of a general response set to the test as mentioned by Cline *et al.* (3), but more a function of the amount of experience a woman has had with the mother role as stated by Schaefer (7).

Questionnaire 2 was factor analysed to determine the factorial validity of PARI scales which were reversed. The assumption was that if the PARI scales did not constitute stable factors, then changes introduced in the direction of item phrasing and scoring would tend to make the factor structure even more unstable. On the other hand, if there were a few regularly emerging factors, they would tend to reappear even when the items are reversed. Table 5 shows that the first two factors in both questionnaires are highly similar. To this extent, the factorial validity of PARI scales in reversed item-forms is maintained. However, changes in the direction of item phrasing do tend to reflect on the composition and characteristics of the factors as described by the scales in second analysis. While the factors within Q.2 are independent (only F_{21} is slightly correlated with F_{24}), the factors within Q.1 are not all independent. Therefore, F_{21} shows high positive correlation with F_{11} and F_{14}, and at the same time shows a negative correlation with F_{15}. The relationship here is somewhat similar to that shown between F_A and F_{11}, F_{14}, and F_{15}. The second factor in both questionnaires is almost identical. However, it appears that the factors in Q.2 are primarily descriptions of a variety of Control dimensions, such as Punishment Orientation (or Firm Control, F_{23}), Firm Discipline (F_{24}), and Control through Suppression (F_{26}), and to some extent Hostile Neglect (F_{25}). Therefore, F_{24} correlates not only positively with F_{11} and F_{14}, but also negatively with F_{15}. Similarly, F_{26} tends to correlate with F_{14}, while F_{23} shows a positive correlation with F_{11}. Thus in the reversed questionnaire form, the first two factors—i.e., Authoritarian-Control and Hostility-Rejection—reappear. Therefore, the factorial validity of PARI scales in reversed form is maintained. From a comparison of Q.1 and 2 factor structures with that of Zuckerman *et al.*'s, as well as Schaefer and Bell's analyses, it appears that the factors remain stable and replicable across samples.

E. SUMMARY

Mother's Forms of Parental Attitude Research Instrument (PARI) were administered in groups to 293 female college students. Administration of unreversed questionnaires (Q.1) was followed by a second reversed item questionnaire a week later. The *S*s were first year students in introductory psychology at the University of Manitoba, and were drawn from different fac-

ulties and schools on campus. Factor analyses of 23 × 23 (Q.1) and 20 × 20 (Q.2) scale correlation matrices yielded five and six factors respectively. The coefficients of similarity calculated between corresponding factors of Q.1 and those of previous analyses [i.e., Zuckerman, *et al.* (13) and Schaefer and Bell (10)] showed three factors to be highly replicable. The factor structures of Qs. 1 and 2 corresponded highly the complex factor structure obtained by Schaefer and Bell in the sample of unmarried nurses. The finding supported Schaefer's statement that less experienced women would reveal a more complex factor structure than experienced mothers. The factorial validity of the PARI scales was not changed as a result of changes in the direction of items.

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COMMUNITY DIFFERENCES IN POSITIVE MENTAL HEALTH OF YOUNGER WORKERS*

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A. INTRODUCTION

The purpose of the present study is to investigate differences in the positive mental health of younger workers in two communities—a small town in northeast New York, and a large city in the Midwest with a southern background. This study is in line with present interest (2, 8, 9) in community dynamics and mental health, particularly in two respects: (*a*) the emphasis is on mental health rather than mental illness; and (*b*) consideration is given to the ecological conception as presented by Kelly (8), and to the principle of interdependence and reciprocity between structures and functions.

A search of the literature on mental health, social class, and mental illness (e.g., 4, 5, 7) reveals no attention to community difference problems. The literature on rural-urban and community differences reveals a number of studies concerned with such problems as research on the urban fringe (1) and occupational composition in the metropolitan hierarchy (3), but none on rural-urban differences in mental health. The most comprehensive volume on mental health in industry (10), a study completely based on Detroit auto workers, also is not concerned with community differences. All of which is to say that the study of community differences in mental health has been a neglected problem that is worth investigating. The present study is concerned with one phase of the problem—namely, community differences in the positive mental health of younger workers in two industrial settings—and, in a sense, it is a follow-up of our earlier study (13). The same subjects and the same settings are used. The previous study was concerned with differences in memories of experiences in two settings; this one is concerned with the evaluation of those experiences in terms of mental health indices determined by content analysis of life and work stories available for the workers in both settings. The hypotheses of the present study are: (*a*) The workers from a small town will rate higher in total mental health index than the workers from the city.

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(*b*) The city workers will rate higher in one index of mental health: maturity. The second hypothesis is based on the assumption that the workers from the city will have a factor of advantage for developing maturity because they have available a larger and more diversified range of experience and more potential versatility for gaining from experience as compared with small-town workers. (*c*) The small-town workers will rate higher than the city workers in three mental health indices: relation to environment, personality organization, and self-regard. The third hypothesis is based on the assumption that small-town workers will have the advantage of relatively well-established life situations which are emotionally acceptable to people living there, even though breadth, depth, and versatility of experience may be lacking.

B. METHOD

1. *Subjects, Setting, and Procedure*

The subjects were 129 male workers under 40 years of age, taken from two companies located in two different communities, including 67 workers from a small-town company and 62 workers from a large city firm. Thus, age and sex factors were held constant. The upper limit of 40 years of age was selected because the findings of an earlier study (11) showed that the memories of workers above 40 differed significantly from those below 40.

The small-town company was located in a two-college town in upstate New York. In this area the town was thought of as a desirable place to live. The subjects worked in a paper mill, the only plant of any size in the community. Obtaining a job there was considered by many workers to be the beginning of establishment and was so conceived by the community. Fishing and hunting were frequent interests of the townspeople. There was a larger than average number of children per family. The town had a weekly newspaper, and it had available papers from adjacent, larger places.

The large city plant was located in the west end of a Midwest city; and it obtained workers from the suburbs, as well as from the city. The city had two large universities and a well-known cosmopolitan newspaper, as well as other city facilities—museums, zoos, open-air opera, etc. The population for the metropolitan area was more than two million. Many factories and other opportunities made mobility significantly easier than in the small town. The two plants did, however, have similar patterns of management and the same psychological consultant.

The source material used was based on interviews of workers in both plants, carried on by the senior author. The interview was structured in the following sequence:

1. Direct questioning about work, family, personal story, and present conditions or problems.
2. Recall of the most outstanding pleasant experience with the question, "And now tell me what comes to your mind when you think of the most outstanding pleasant experience of your life."
3. Recall of other outstanding pleasant experiences.
4. Recall of the most outstanding unpleasant experience.
5. Recall of other outstanding unpleasant experiences.

2. *Assessing Mental Health*

For the purpose of assessing mental health, the interview material was broken down into two individual sentences; and those sentences, approximately 15 per record, which were felt to be indicative of the worker's mental health were underlined. Each of the sentences was then individually scored and placed into one of the four categories that were chosen to be indicative of the worker's positive mental health. These categories were adapted from Jahoda (6) and constitute a condensation of her six major categories of criteria for total positive mental health.

The four categories were as follows:

1. *Self-regard.* The attitudes an individual has toward himself make up the first category. A sentence would be scored positively and placed in this category if it indicated some measure of self-acceptance, self-confidence, self-reliance, and sense of identity. The following are examples of such a score: "Cecil thinks his family is a close-knit one"; "He is well-satisfied with the way he handles his job"; and "He feels he is an important part of the paper processing." A sentence would be scored negatively and placed in this category if it indicated a lack of the above qualities (such as lack of self-acceptance). The following are examples of responses so scored: "He expresses a feeling of worthlessness"; "He and his wife always seem to be fighting and he finds himself staying away from home as much as possible"; "He feels he is too slow to become a good machine operator."

2. *Maturity.* This category designates the workers' degree of growth development and self-actualization as reflected, especially, in his sense of responsibility and his trustworthiness as a worker. Examples of sentences placed in this category and scored positively follow: "He steadily worked himself into the responsible position he now holds"; "His drive and initiative are very

high." On the other hand, sentences in this category that would be scored negatively would be "He needs constant supervision and continual reminding"; "There is considerable question about his initiative"; and "He is a young man who is not as self-challenging as he could be."

3. *Personality organization.* This category is an assessment of the personality structure of the worker and designates such traits as resistance to stress, a unifying outlook on life (integration and balance of the personality), and good reality orientation. Special consideration is given to the firmness of the personality as opposed to either looseness (lack of firm organization) or rigidity (intolerance). The following are examples of sentences that would be scored positively and placed in this category: "He shows a willingness to face realities and do well by them"; "He is a stable individual who never seems to get riled"; and "He has the strength to stand up for his convictions." On the other hand, examples of sentences that would be scored negatively and placed in this category are "He is disrupted whenever he has to make any change in his job routine"; "He is relatively insecure in his job"; and "He seems to be swayed very easily by his fellow workers."

4. *Relation to environment.* This category designates the worker's adequacy in interpersonal relations and efficiency in meeting situation requirements, his sensitivity to others, and his adjustment to the situation. Consideration is also given to the reaction of other people to the worker being interviewed. Examples of sentences scored positive and placed in this category are "He is an excellent leader and all of his subordinates seem to like him"; and "He is always going to bat for someone else." On the other hand, sentences that would be scored negatively and placed in this category are "He has absolutely no social graces"; "He reported grievances with every man that has worked with him"; and "He talked of running away from his present situation."

After each of the underlined sentences and interviews was scored either positively or negatively and placed in one of the four categories, the indices of positive mental health of the work could be given. The score for each individual category was determined by subtracting the number of negative statements from the positive ones in that category. The overall total mental health index was determined by adding the four category scores.

A second judge scored 25 of the interviews according to the criteria and categories defined above. The same underlined sentences were used for both scorings. The interjudge reliability for the total index was found to be .85 and the reliabilities for the four categories were found to be .81 for self-regard, .86 for maturity, .71 for personality organization, and .77 for relation to environment.

C. RESULTS

1. *Community Differences in Positive Mental Health*

Two statistically significant differences show up in the analyzing of comparisons of the means between the small-town workers and the large-city workers in all the component factors of mental health and the total mental health index: namely, (*a*) maturity in favor of the large-city workers and (*b*) relation to environment in favor of the small-town workers. All other differences are not statistically significant. This and related information about the facts in each particular component factor of mental health, as well as the total, are presented in Table 1.

TABLE 1
COMMUNITY DIFFERENCES IN POSITIVE MENTAL HEALTH

Positive mental health index	Small town *Mean*	Small town *S.D.*	Large city *Mean*	Large city *S.D.*	Difference between means
Self regard	2.06	1.61	2.19	1.42	—.13
Maturity	.25	2.42	1.05	1.88	—.80*
Personality organization	—.30	1.95	—.60	2.32	.30
Relation to environment	.63	1.85	—.28	1.65	.92**
Total index	2.64	4.32	2.36	4.22	.28

* Significant at the .05 level.
** Significant at the .01 level.

Table 1 shows that in all of the factors the differences, as far as direction is concerned, are in line with the hypotheses made. However, on three out of the five factors reported, the differences are statistically not significant: e.g., on self-regard, there is very little difference but the little difference is in favor of the large city, in accordance with the hypothesis; on maturity, there is a statistically significant difference in favor of workers in the large city, in accord with the second hypothesis; in personality organization, what little difference exists is in favor of the workers from a rural community, in line with the third hypothesis as far as direction is concerned; in relation to environment, the difference is in favor of the small-town workers and is significant at a 1.1 level; and finally, in the total mental health index, again the difference is statistically not significant, but the little difference indicated is in the direction of the small-town workers being more healthy-minded than the city workers. In three out of the five factors reported on, the small-town workers have higher mental health indices than the large-city workers. Somehow, the small town and the plant located therein possess more factors that support healthy-mindedness than do the large city and its plant. The two statistically significant factors will be considered under "Discussion."

D. DISCUSSION

The study on community differences in memory optimism (13) revealed that statistically significant differences found in family and marriage show up more often a source of pleasantness for workers in a small town. This contributed toward their missing home more when in the service and more often expressing a desire to be back home. Factors of this kind not only play a role in contributing to memory optimism, but also toward mental health. As a matter of fact, in another study on memory optimism as related to positive mental health (12), all of the mental health factors correlated positively with every component studied. The correlation for self-regard was between positive mental health and memory optimism .32, with maturity .19, with personality organization .20, with relation to environment .18, and with the total mental health .40. Hence, much that was said and revealed in the article on community differences in memory optimism is applicable here: the same two towns with the same workers, having the same memories, pleasant and unpleasant experiences, which characterize them as human beings in the worlds they live in. The chief difference found that evidently plays a role here, too, is that the small-town group shows significantly more pleasant memories concerning family, marriage, and discharge from the service; and the city groups show significantly more pleasant memories concerning achievement, hobbies, health, and friends. The latter factors contribute toward the maturity factor on which the city workers rate higher. The factors of family, marriage, and discharge from the service contribute toward relation to environment, in which the small-town workers rate higher.

In summary, it can be said that the strength underlying the positive mental health of the small town is characterized by favorable interpersonal family relationships. And the peculiar strength of the large city seems to lie in the development of mature responsibility by stress on success and achievement. It would be interesting to study these factors in a larger population, including older workers, in an experimentally designed fashion.

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PERIFLASH*[1]

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This paper describes an interesting visual phenomenon for which I have found no description or explanation.

Periflash is a neologism built up from "peri" meaning "about," "outer," and "flash," meaning a short, intense experience. Periflash describes this sudden, large increase in the apparent intensity or brightness of a light stimulus. Anyone can observe the phenomena under nonlaboratory, real-life conditions.

I first observed periflash about 8 a.m. as I was driving down a street with overhanging street lights. As I approached the light I noticed in my peripheral vision an apparent flash just as the street light was obscured by the front top metal roof of the car. The sky was fully overcast or cloudy. As I slowed the car the phenomenon diminished and finally disappeared.

Subsequent investigation and analysis yielded the following facilitating conditions:

> Light source: White mercury vapor light, 400 watts, 20,000 lumens, 30 feet high
>
> Background: Dull, cloudy, greyish dawn
>
> Velocity: Threshold—12 to 20 mph. Best observed—30 to 50 mph
>
> Fixation: Looking straight ahead, parallel to road
>
> Peripheral Angle: 45° above horizontal, opaque termination of light source
>
> Flash Intensity: 300 percent-1000 percent increase in apparent brightness or intensity

Figure 1 shows a schematic and generalized description of periflash.

The descriptive equation for periflash is $P = f\ (\Theta, I, V)$. [1]

Periflash (P) is a function of the angle (Θ) (displacement of the light stimulus from the line of visual fixation), intensity (I) of the light, and the velocity (V) of the diminishing distance between the light and the observer. Laboratory investigation should provide the functional parameters in equation [1].

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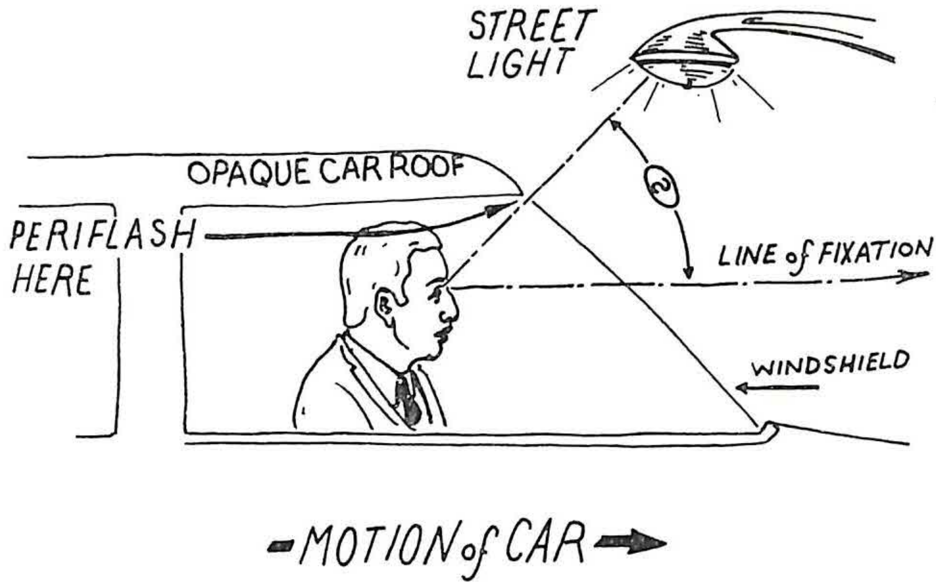

FIGURE 1
GENERAL DEPICTION OF CONDITIONS PRODUCING PERIFLASH

I contemplated and rejected several possible explanations: After lag, positive after image, a light stimulus suddenly passing from foveal cones to peripheral rods, and so on.

The explanation I find most promising is a combination of after lag plus contrast effect. The light is moderately bright in contrast to the cloudy grey background. Where the car roof cuts off the light, visual after lag is suddenly thrown into sharp contrast with the opaque roof. Since the intensive and temporal properties of the after lag are about equal to the intensive properties of the actual stimulus for a few milliseconds, this would probably explain not only short flash effects, but also the apparent increase in brightness (the same "light" on a much darker background).

The combination of after lag and contrast effect leave two questions still unanswered. First, why does there appear such a *great* increase in brightness? Second, why doesn't this phenomenon appear in the fovea? These questions could be reformulated as interesting hypotheses for more definitive laboratory investigations.

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CULTURE AND STRATEGIC CHOICE*

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A. INTRODUCTION

A measure of individual preference to play in games that offer higher rewards for competitive strategic behavior has been found related to social risk attitude (5, 6). The relation was observed in samples of male students at the University of Virginia, and the question remains whether it would hold in other communities. Apart from relations within communities, the preference for competitive strategy might also differ across communities. Here we compare samples of British and American university students to investigate possible cultural differences in strategic choice.

B. METHOD

Three personality scales were administered, together with the competitive strategy preference test, to the subjects in each sample. The three tests are (*a*) the Kogan and Wallach (1) test of social risk preference, (*b*) the Sampson and Smith (4) scale of world-minded attitude, and (*c*) a tolerance for ambiguity measure as modified by Pilisuk *et al.* (3). The Kogan and Wallach test gives a series of social choice situations for which the subject is to name the probability of success he would want to have before choosing a risky action. The world-minded measure and the tolerance for ambiguity measure each contain a series of statements with which the subject expresses degree of agreement (or disagreement) on a six point scale. The competitive strategy preference measure gives the subject a series of choices between two prisoner's dilemma games in which to play. In each pair of games, one game matrix offers relatively more gain from using competitive strategies than does the other game matrix. The games are described and applied in (5) and (6).

Each subject's score in the Kogan and Wallach test was subtracted from 100, so that higher scores would indicate a greater preference for social risk. Tolerance for ambiguity and world-mindedness were scaled so that larger positive numbers represented greater tolerance for ambiguity and greater world-mindedness. The number of times each subject chose a game matrix

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(out of nine choices)[1] that offered greater gain from competitive behavior was taken as his competitive preference measure.

Two samples of British university students are to be compared with one American sample. The two British university samples were obtained from among students in the economics department at the University of Bristol. One sample included 30 first year students who volunteered from principles of economics classes. The other sample included 27 third year students enrolled in one course in the economics of industry. The American sample included 20 students in two undergraduate economics courses at Harvard University's Summer School. The 20 students represented 17 different institutions. While such wide representation is desirable, the sample has the disadvantage of being self-selected. Students who choose to spend a summer term at Harvard may not correspond to a random sample from as many different institutions.

C. Results

The null hypothesis that British and American samples were drawn from the same underlying population was tested for each measure using the Mann-Whitney U test. For particular sample comparisons, Table 1 gives the Probability of finding samples as different as these when their underlying population is the same.

TABLE 1
Probability That Compared Samples Were Drawn From Same Population
(2-Tail Mann-Whitney U Test)

Samples compared	Scores compared Compet. pref.	Risk pref.	World-minded
Bristol 1 and Harvard	.03	.53	.70
Bristol 3 and Harvard	.06	.01	.05
All Bristol and Harvard	.02	—	—

The British samples showed significantly greater preference ($p = .02$) for strategic choices that offer greater competitive opportunities. The median number of competitive matrices chosen was 7 and 8 (out of a possible 9) for first and third year Bristol samples, and only 5 for the Harvard sample. Thus, each of the separate Bristol samples showed this difference from the Harvard sample in competitive preference. Contrasts in the other measures are not so clear. No differences were apparent in tolerance for ambiguity so tests for that measure are not reported. The sample of third year Bristol students differed significantly from the Harvard Summer School sample in both preference for social risk and world-mindedness. But it differed also from the sample of first year Bristol students, and so no combined British sample was made for these measures. The third year Bristol students were exceptionally averse to social risk and were also less world-minded than the other samples.[2]

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[1] Matrix choice ten, shown in Figure 1 of reference (6, p. 192), was omitted because it does not permit a distinction between competitive or cooperative matrix preference. The same nine matrix choices were used in (5).

Within each sample, each personality measure was compared with competitive strategic choice to see whether relations which had been observed earlier (6) in samples of University of Virginia students would hold again. The Spearman coefficients of rank correlation (adjusted for ties) of each personality scale with competitive matrix choice are shown in Table 2, together with the Kendall coefficient of concordance (adjusted for ties) for all four measures. The Harvard Summer School students and first year Bristol students showed roughly the same relations observed before: social risk preference correlated with competitive strategic choice and all four measures were associated. The third year Bristol sample exhibited none of these relations. The third year sample participated as members of a class, and that might have affected their responses, yet there is no satisfactory explanation for the failure of these relations to hold in that sample. We know only (see Table 1) that the Bristol third year sample differed sharply from the other samples in most of the personality measures that were observed.

TABLE 2
SUMMARY OF WITHIN-SAMPLE ASSOCIATIONS

Group (*N*)	Correlation with competitive preference Risk pref.	 Toler. ambig.	 World-minded	Coefficient of concordance for all four measures
Bristol 1 (30)	.27*	.06	—.05	.37**
Bristol 3 (27)	—.06	—.03	.08	.26
Harvard (20)	.42**	.11	.22	.40**

* $p < .10$.
** $p < .05$.

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[2] The third year Bristol students are not significantly less averse to social risk than the sample of Virginia students presented earlier (6), however, and the Harvard and Virginia samples show different world-mindedness. But the Virginia sample corresponds with the Harvard sample in competitive strategy preference, as if they were from the same population, and also is significantly different from both British samples.

D. Summary

The extent of preference for competitive strategic choices can vary from one culture to another as well as with risk attitudes among individuals within a culture. Results reported here show unexplained differences between the two British samples. British university students may be even less representative of their society than are American students of theirs, because the British students form a smaller fraction of their age population. Nevertheless, within these samples there are similarities to earlier results: in the American sample and in one Bristol sample, preference for risk was associated with competitive strategic choices. Compared with Americans, the British subjects showed a greater preference for competitive strategic choices.

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THE RELATIVE IMPORTANCE OF SELECTED BEHAVIORAL CHARACTERISTICS OF GROUP MEMBERS IN AN EXTREME ENVIRONMENT* [1]

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A. INTRODUCTION

It is generally accepted that certain behavioral characteristics, manifested by members of a group, relate to the well-being of most groups. Among these behaviors are leadership performance, task performance, social compatibility, and emotional stability. Mann (5) in his review of personality and performance in small groups clearly indicates that these behavioral traits are frequently used as dependent variables in small group research. These traits have also been among the major criteria used by the U.S. Navy in evaluating the performance of personnel wintering-over at the small stations in Antarctica (4).

The assumption is that, in general, the high end of the continuum for each of these four behavioral dimensions reflects a positive valence—i.e., it is considered a desirable trait of the group member. Although there is a plethora of studies investigating possible correlates of these dimensions there is a dearth of research concerned with their relative importance for different groups and for different group situations. It is not difficult to imagine that the hierarchy of importance assigned to these behavioral characteristics by group peers will vary with the nature and mission of the groups. An extreme example of this would be the large valence difference of high task performance when comparing two work groups; one group organized under a type of Scanlon Plan where the group benefits from high performance, the other group consisting of work rate "restricters" (2).

A second, and more specific, reason for investigating the relative importance of these behavioral characteristics relates to the Navy's efforts to en-

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hance the efficiency of screening procedures for selecting the Antarctic wintering-over personnel. These efforts have led to the development of multiple regression equations for the prediction of each of these behavioral trait criteria. While these various predicted scores correlate positively there is enough variation to question their relative importance. Information regarding this importance hierarchy would not only provide an improved basis for selection but would furnish additional insight into the behavioral demands of this unique environmental situation.

In response to these questions the present study attempted to estimate the relative importance of these four behavioral traits as seen by members of groups isolated from the "outside" world for long periods of time in an extreme environment: viz., the wintering-over small stations in Antarctica.

B. METHOD

1. *Subjects*

The subjects for this study consisted of 214 Navy enlisted men and 125 civilian scientists who wintered-over at one of the small stations between the years of 1963-1968. The Navy enlisted group reflect two rather broad but distinct occupational groups: namely, Navy construction personnel ("Seabees") and Navy technical-administrative personnel. Previous research (1) has suggested that it is prudent, in most analyses, to keep these two occupational groups, in addition to the civilians, separate. The Navy enlisted sample divided into 121 Seabees and 93 technical-administrative types.

2. *Procedure*

Near the end of the winter isolation peer nominations were obtained from all subjects for the following items:

(1) Name five men at this station who seemed to be most calm and even-tempered even in frustrating or emergency situations. (Emotional Stability)

(2) Name five men who seemed to be friendliest and most popular among most of the station members. (Social Compatibility)

(3) Which person, or persons, impressed you most by their ability to provide leadership for others when it was needed. (Leadership)

(4) Name five men at this station who seemed to be most industrious and hardest working in carrying out their jobs and other tasks around the station. (Task Performance)

(5) Whom have you found to be your closest friend(s) during the past few months? (Control item)

(6) If you were given the task of selecting men to winter-over at a small station, which five men from this station would you choose first? (Criterion)

It should be noted that the station members were free to nominate anyone at the station regardless of occupational group. In addition, they were assured that all questionnaires were to be kept in confidential files and were to be used for research purposes only.

C. RESULTS

The basic data for this study are presented in Table 1. This table provides, for each occupational group, the intercorrelations of the four behavior items, the control item regarding friend(s), and the criterion item that asks the group members to nominate the five men they would select first to winter-over at a small station. Based upon these intercorrelations Hotelling *t*-tests (3) were computed to determine the significance of the differences between the various behavior item (and control item)-criterion item correlations. The results of the *t*-test analysis are presented in Table 2.

The results shown in Table 2 suggest that station members nominating Seabees for wintering-over consider emotional stability, task performance, and social compatibility as being significantly more important than leadership

TABLE 1
INTERCORRELATION OF ITEMS FOR EACH OCCUPATIONAL GROUP COMPARISON

Item	Emotion	Task	Social	Leader	(Con-trol)	Crite-rion
Emotion						
Seabees ($N = 121$)		.46	.56	.38	.53	.74
Technical-Administrative ($N = 93$)		.53	.50	.57	.46	.74
Civilians ($N = 125$)		.47	.61	.38	.37	.67
Task						
Seabees			.45	.46	.34	.67
Technical-Administrative			.42	.54	.44	.65
Civilians			.49	.45	.38	.61
Social						
Seabees				.22	.70	.64
Technical-Administrative				.34	.61	.55
Civilians				.35	.58	.69
Leadership						
Seabees					.20	.43
Technical-Administrative					.45	.49
Civilians					.26	.48
(Control)						
Seabees						.57
Technical-Administrative						.49
Civilians						.57

TABLE 2

t-TESTS OF THE DIFFERENCES BETWEEN THE BEHAVIOR (AND CONTROL) ITEM-CRITERION ITEM CORRELATIONS

Behavior item	Comparison behavior item	Occupational group Seabee	Tech.-Admin.	Civilian
Emotion	Task	1.30	1.55	.99
Emotion	Social	1.54	2.78**	—.49
Emotion	Leadership	4.41**	3.90**	2.60*
Emotion	(Control)	2.76**	3.51**	1.45
Task	Social	.18	1.15	—1.46
Task	Leadership	3.21**	2.12*	1.70
Task	(Control)	1.27	1.90	.50
Social	Leadership	2.69**	.74	3.02**
Social	(Control)	1.46	.83	2.14*
Leadership	(Control)	—1.60[a]	—.07	—1.06
		$N = 121$	$N = 93$	$N = 125$

[a] Negative *t* values indicate that the Comparison Behavior Item had the higher correlation with the criterion.

* $p < .05$.

** $p < .01$.

performance. Emotional stability also had a significantly higher relationship to the criterion than did the friendship control item.

For nominations of technical-administrative personnel the findings suggest that emotional stability was valued significantly more than social compatibility, leadership, and friendship. In addition, task performance had a significantly higher relationship to the criterion than did leadership performance.

Analysis of the peer ratings for the civilians indicates that emotional stability was considered to be a more relevant behavioral characteristic to wintering-over than leadership performance. Also social compatibility related more highly to the criterion than did either leadership performance or friendship.

The behavioral (and control) items are rank ordered according to their correlations with the criterion in Table 3. For the two Navy occupational groups there was almost perfect agreement as to the relative importance of the behavioral traits with emotional stability being first and leadership performance ranking last. Nominations of the civilians on the criterion item, however, related most closely with scores on social compatibility closely followed by scores on emotional stability and task performance. As with the two Navy occupational groups leadership performance scores had the lowest correlation with the criterion.

Presented in Table 4 are the means and standard deviations of the item scores for each occupational group. Each man received a score for each of the items, in the form of standard scores derived from T-score distributions (*Mean* = 50, *S.D.* = 10) to compensate for station differences. The Navy enlisted men apparently are nominated more frequently and receive higher scores on the various items than do the civilians. This is especially true in the case of the Seabees on the task performance trait. Probably this is the result of two influences: (*a*) the Navy men nominate within their own group more so than the civilians, and (*b*) the required task performance behavior of the Navy man, especially the Seabee is more physically strenuous and more easily observed.

TABLE 3
RANK ORDER OF BEHAVIOR (AND CONTROL) ITEMS BY CORRELATIONS WITH CRITERION

Behavior item	Seabee	Occupational group Tech.-Admin.	Civilian
Emotional Stability	1	1	2
Task Performance	2	2	3
Social Compatibility	3	3	1
Leadership Performance	5	4.5	5
Friendship (Control)	4	4.5	4
	N = 121	*N* = 93	*N* = 125

TABLE 4
MEANS AND STANDARD DEVIATIONS OF ITEM SCORES FOR EACH OCCUPATIONAL GROUP

	Seabee		Tech.-Admin.		Civilian	
Item	*Mean*	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*
Emotion	52.14	8.75	50.98	9.88	47.17	8.65
Task	53.60	8.90	51.32	8.90	46.08	8.02
Social	52.11	8.47	52.42	8.63	46.61	8.52
Leadership	52.28	8.47	51.39	8.46	47.96	6.14
(Control)	52.30	7.99	50.53	9.82	47.96	8.70
Criterion	52.15	8.73	51.85	8.88	46.04	8.54
	N = 121		*N* = 93		*N* = 125	

D. DISCUSSION

The results, in general, strongly suggest that the subjects of this study wanted most from their fellow group members an expression of emotional stability and social compatibility. In the case of the military it was emotional stability; for the civilians, social compatibility. Although there was a slight difference in trait emphasis between the groups there was agreement in their stressing a personality-oriented trait rather than a task-oriented behavior. The significance of this emphasis is underlined by the relatively low relationship between the friendship (control) item and the criterion item. In other words, something more than a friendship factor was being expressed in the emotional stability-criterion relationship and social compatibility-criterion relationship.

The relatively low correlation between leadership performance and the criterion scores based upon peer nominations to winter-over again may, for the military, be a function of the nature of the organization. One would assume that individuals in the lower rates had less opportunity to manifest leadership behavior than those in the higher rates. Such a circumstance would tend to reduce the overall relationship between the two variables. However, the same relatively low relationship found within the civilian group cannot be so easily explained. The role of the civilian is much more autonomous than that of the military, and opportunities to demonstrate leadership behavior are correspondingly less restricted.

It, perhaps, would be prudent to interpret the results of the present study as being more suggestive than definitive. However, it would seem to be a reasonable and realistic appraisal by wintering-over station members to give added emphasis to emotional stability and social compatibility behavior. The survival of a group isolated together in a hostile environment for many months would probably be most threatened by an emotionally unstable and socially incompatible atmosphere.

E. Summary

The present study attempted to estimate the relative importance of four behavioral characteristics—viz., leadership performance, task performance, social compatibility, and emotional stability—as perceived by Navy enlisted and civilian scientific members of the small stations in Antarctica. The results suggest that the most important behavior looked for in the Navy enlisted man was that of emotional stability, while social compatibility was the most important trait that could be manifested by the civilian scientists. There was a consistency in the emphasis of the personality-oriented behaviors rather than the task-oriented behaviors for both the military and civilian contingents. A control variable (friendship) showed only a relatively low relationship to the criterion.

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NONVERBAL RIGIDITY AND PERSEVERATION*

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A. INTRODUCTION

Recent research (1, 2, 3, 9) on a new test of nonverbal rigidity, the Breskin Rigidity Test (BRT), has demonstrated consistent and predictable individual differences in various cognitive tasks across various age groups. The rationale of the BRT is based upon the assumption, derived from the Gestalt law of *Praegnanz,* that "a more rigid person, given the opportunity to express a preference between pairs of figures differing only in 'goodness of fit,' will tend to select the 'better fit' " (1). Prior work on the construct of rigidity began with Neisser (14), who coined the term "perseveration" and defined it as an abnormally persistent repetition or continuation of an activity after the activity had once begun or had recently been completed. Neisser's concept of perseveration has been represented in many of the subsequent measures and studies of rigidity which have employed tests of sensory, motor, and conceptual perseveration (4, 10, 11, 12, 15, 19). In general, these previous studies have shown rigidity to be a maladaptive factor in task performance. Contrary to this position, however, is the concept derived from psychoanalytic ego psychology and from clinical neurology which implies that the rigid person may perform successfully in some detailed compulsive tasks (8, 17). Shapiro (17), commenting upon obsessive-compulsive intellectual rigidity, stated that ". . . the same qualities that make these people seem so rigid in one context endow them, in another, with excellent facility and an impressive capacity for concentration on a technical problem (p. 30)." Thus, under this view, those measures of flexibility which depend upon ability to rapidly perform some repetitive task and which, at various junctures, would require changes in set, may be instead measures of rigidity. As the BRT has been used to measure various aspects of rigidity (1, 2, 3, 9), this study explored the relationship of rigidity, as measured by the BRT, to tests of perseverative rigidity.

B. EXPERIMENT 1

Thirty-four undergraduate psychology students enrolled at Queens College were given the BRT and the Test of Behavioral Rigidity (TRB) (15, 16).

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The TBR emerged from a factor analysis of a representative group of prior rigidity measures and yielded a three-dimensional factor structure. The three factors were (*a*) motor-cognitive rigidity—the ability to shift without difficulty from one activity to another, (*b*) personality-perceptual rigidity—the ability to adjust readily to changes in cognitive and environmental patterns, and (*c*) psychomotor speed—the rate of emission of familiar cognitive responses. Factors (*a*) and (*c*) were measured by objective tasks of motor sensory perseveration, whereas factor (*b*) was measured by personality questionnaire items. The correlations between the BRT and the three factors of the TBR were —.40 ($p < .05$) with factor (*a*); .02 ($p > .05$) with factor (*b*), and —.10 ($p > .05$) with factor (*c*).

C. Experiment 2

The Stroop Color-Word test (18) has been employed as a measure of the cognitive style of constricted *vs.* flexible control (6, 7). In this test, *S*s are asked to name the colors of ink used on contradictory color names; i.e., the word "red" is printed in blue ink. *S*s who are able to overcome the tendency to read the color-word, while attending to the actual color of ink in which the word is printed, are labelled as "flexible."

*S*s were 42 female undergraduates enrolled in child psychology courses at Nassau Community College. *S*s were given the BRT and then were individually tested with a group form of the Stroop Color-Word test (13). Following the procedure of Gardner *et al.* (7), an interference score was computed for each *S*. In this scoring system, the larger scores indicate increasing rigidity. The distribution of *S*s was divided into thirds on the basis of their BRT scores and the mean interference scores of *S*s in each third were then compared by a single factor analysis of variance. The means of the high, middle, and low BRT scorers were, respectively, —3.24, .61, and 3.28. The results of the analysis of variance were significant ($F = 3.60$, $df = 2/39$, $p < .05$) and a Duncan multiple range test showed that the interference scores of the low and high BRT scorers were significantly different from each other, although neither was significantly different from the interference scores of the middle BRT group. The correlation ration *eta* (5) was .40 and indicated that high BRT scores (rigid) were associated with low interference scores.

D. Discussion

Experiment 1 indicated that "rigidity," as measured by the BRT, is negatively related to motor-cognitive and psychomotor speed rigidity measures, although only the result for motor-cognitive rigidity was significant. The significant findings on Experiment 2 tend to confirm this result, showing the tendency of *S*s with higher BRT scores (more rigid) to receive lower interference scores (less rigid) on the color-word test.

A possible explanation for these results may be found in the previously mentioned ego psychology concept of rigidity which considers the possibility that a rigid person might be particularly facile in performing some detailed kinds of tasks. The restriction of attention characteristic of rigid, compulsive personality styles may actually enhance performance on some of the measures employed in the present study. If this is tenable, then the BRT may measure what Shapiro (17) has called "obsessive-compulsive intellectual rigidity." Further research, in which independent clinical judgements of rigidity can be employed, will be required to give more meaningful support to this proposed relationship.

E. SUMMARY

This study has investigated, in two separate experiments, the relationship between rigidity as measured by the Breskin Rigidity Test (BRT) and Schaie's Test of Behavioral Rigidity (TBR), and the BRT and the Stroop Color-Word test. The results indicated that the BRT scores were *negatively* related to those of both other tests. A possible explanation was offered that the restriction of attention characteristic of rigid, compulsive personality styles may actually facilitate performance on the detailed tasks of the TBR and color-word tests.

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COMPARISON BETWEEN AMERICANS LIVING IN ISRAEL AND THOSE WHO RETURNED TO AMERICA: PART II, ISRAELI BACKGROUND*[1]

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A. INTRODUCTION

Native Americans who became permanent residents of Israel during the years 1962 through 1966, and returnees to America who had lived in Israel a year or more, provided information about their American background and their experience in Israel, and made predictions about America and Israel. The views of permanent residents gathered in 1967 were compared on the basis of religious identification in Israel (8, 9, 10). Returnees who responded in 1968 to a similar questionnaire are compared in this second series with the permanent residents in Israel.

Part I focused upon American background (11). Returnees were more rooted in America. More returnees had native parents, more attended post graduate school, and more affiliated with Hillel, a Jewish collegiate organization. More of those who quit Israel readily identified as Conservative, the religious movement indigenous to America which developed in the belief that Jews are at home in America (5).

Part II focuses upon Israel. Attractions of the Jewish homeland are a source of ethnic dissonance, drawing olim (immigrants to Israel) also troubled by aspects of American life. The *committed* who *voluntarily* quit America's affluent society (3) were both "pulled" by Israel and "pushed" from America (15). This section also relates the adjustment of these immigrants to Israel, and provides their economic comparisons between Israel and America. Subjective comparisons reflect the striving of individuals on opposite sides of the ocean to rationalize their position (2, 4, 12, 13).

More permanent settlers than returnees came to Israel after 1962 as eco-

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nomic conditions steadily improved for educated Americans (11). A causal relationship between economics and ability to remain in Israel is explored along with considerations of ethnic commitment.

B. METHOD

1. *Subjects*

From the registry of permanent residents of Israel were selected 780 Americans born in the United States or Canada who became permanent residents of Israel during the years 1962 through 1966, and were 20 years of age or older by the end of 1966. Of 703 eligible subjects in 1967 443 cooperated, a 63 percent response.

Names of returnees sampled were provided by those who had completed questionnaires in Israel in response to a request for names and addresses of Americans who had lived in Israel and returned to America. Also, the inactive membership file of the Association of Americans and Canadians in Israel provided additional names. A third source were respondents in America. These provided 256 native born American respondents who had lived a year or more in Israel and were 20 years of age or older when completing the questionnaire in 1968.

2. *Questionnaire*

The four page self-administering questionnaire used in Israel and in America to gain information about American background and the experience of living in Israel, was identical for the first three pages. The fourth page made allowance for the difference in place of residence.

Subjects were approached similarly through the mail, with each person receiving an explanatory letter and a stamped, self-addressed return envelope along with the questionnaire. In Israel subjects were solicited four times; in America, twice.

3. *Inquiry*

Questions are based upon the assumption that there are differences between Americans settling permanently in Israel and those who live in Israel and return to America. More who stay in Israel should be ethnically attracted to Israel while in America, and after their arrival in Israel, more should feel at ease. The permanent residents' sense of adjustment should be reflected in their greater feeling of economic well-being in Israel noted in their observing less gap between Israel and America's standard of living and career opportunities.

Question 1. Were more permanent residents before aliya (immigration to Israel) ethnically attracted to Israel, and convinced they would manage economically than returnees?

Question 2. Did more permanent residents come to live in Israel at an earlier age than returnees?

Question 3. Did more permanent residents feel at ease in Israel than returnees?

Question 4. Did more permanent residents consider themselves religiously oriented in Israel than returnees?

Question 5. Did more permanent residents work full time, and in their own fields than returnees?

Question 6. Were more permanent residents satisfied with living quarters and working conditions in Israel than returnees?

C. Results

Results presented are based upon chi square (χ^2) tests of goodness of fit. All probabilities (*p*-values) quoted are at levels of significance associated wtih these tests.

Question 1 is negated pertaining to more permanent residents being ethnically attracted to Israel than returnees. Both groups were similarly drawn by Jewish homeland, living among Jews, and desiring a Jewish life. More permanent residents did favor Israel because of Jewish education, while more returnees were attracted by kibbutz life (see Table 1).

When these attracting factors were added together, weighted so that "some" equals 1 and "much" equals 2, the sum of attractions was similar, returnees scoring 806.6 and permanent residents 776.1.

However, Question 1 is affirmed regarding more permanent residents anticipating they would manage to live within their Israeli income: 66.5 percent compared to 58.2 percent for returnees (chi square .05).

Israel's lower economic standards reduced the economic enthusiasm of both groups. Nevertheless, more permanent residents, 57.3 percent, reported managing on their Israeli income in contrast to 47.3 percent of returnees (chi square .02).

In terms of realizing economic expectations of living within Israeli income, there was no difference between settlers: 61.7 percent, and returnees, 62.8 percent. However, more of those who realized their expectations among permanent residents had been optimistic: 69.5 percent as compared to 55.0 percent for returnees (chi square .02). Of those who did not realize their expectations, 63.4 percent of the permanent residents as compared to 65.1 percent of the returnees expected to manage but found it difficult.

Question 2 is negated. The greater sense of economic optimism observed

TABLE 1
ISRAEL'S ATTRACTIONS

	Percentages	
Question	Returnees in America (*N*-256)	Permanent residents in Israel (*N*-443)
Homeland	(*N*-235)	(*N*-407)
none	10.6	12.3
some	25.5	23.6
much	63.8	64.1
Land of Bible	(*N*-231)	(*N*-382)
none	17.3	24.6
some	42.9	35.9
much	39.8	39.5
Jewish life	(*N*-239)	(*N*-397)
none	15.1	17.9
some	28.0	27.7
much	56.9	54.4
Live among Jews	(*N*-238)	(*N*-400)
none	10.9	15.5
some	31.1	26.2
much	58.0	58.2
Career opportunities	(*N*-228)	(*N*-369)
none	53.1	60.2
some	38.6	29.3
much	8.3	10.6
Jewish education	(*N*-229)	(*N*-384)*
none	31.9	28.6
some	30.1	23.4
much	38.0	47.9
Kibbutz life	(*N*-234)**	(*N*-372)
none	47.4	59.7
some	24.4	20.2
much	28.2	20.2

Note: All tables derived from BMD02s—Contingency Table Analysis—Version of April 21, 1965, Health Sciences Computing Facility, UCLA.

* Chi square significant difference = .05.

** Chi square significant difference = .02.

among permanent residents was not reflected in their arriving to live in Israel at an earlier age. More returnees came at a younger age: 53.1 percent under age 25; 35.2 percent, ages 25 through 34; and 11.7 percent, age 35 and over. By contrast, among permanent residents 35.0 percent came under age 25; 34.3 percent, ages 25 through 34; and 30.7 percent, age 35 and over (chi square .001).

Question 3 is negated when evaluating feelings of ease among olim at time of arrival and after one year in Israel. Upon arrival, 74.5 percent of the permanent residents compared to 72.6 percent of returnees were at ease. After one year more returnees felt at ease: 91.6 percent compared to 84.3 percent of the permanent residents (chi square .01). However, settlers who remained in Israel did continue to develop their sense of ease, 95.9 percent; returnees' attitudes remained fixed, 90.7 percent, until they departed Israel (chi square .05).

Though permanent residents always had greater knowledge of Hebrew, the language of Israel, language fluency did not immediately develop a greater sense of ease among permanent residents. At time of arrival 27.2 percent of the permanent residents had some language ability and 37.7 percent, much ability; in contrast, among returnees 35.6 percent had some ability and 28.5 percent, much knowledge of Hebrew (chi square .025). Permanent settlers continued to maintain language superiority: by 1967 88.0 percent had much ability and 11.3 percent, some language facility in comparison to returnees before leaving, of whom 72.8 percent had much ability and 25.6 percent had some language familiarity (chi square .001).

Question 4 is affirmed. More permanent residents considered themselves religiously oriented in Israel: 57.6 percent compared to 45.3 percent of returnees. Religiously oriented in Israel include: traditionalists (masorti), keepers of commandments (shomer mitzvot), observant (dati). Fewer permanent settlers, 42.4 percent, compared to 54.7 percent of returnees considered themselves nonreligious in Israel (chi square .005): against observance (anti dati), not observant (lo dati), secularists (chiloni).[2]

Question 5 is negated. No difference in full time employment was observed during the first year in Israel; yet, before leaving, more returnees were working full time, 65.6 percent, as compared to 55.3 percent of permanent residents (chi square .025). There was no significant difference among those doing work they were trained for: 56.3 percent for permanent residents and 63.1 percent for returnees.

Among returnees were more professionals, 35.2 percent, than among permanent residents, 24.4 percent (chi square .001). More permanent residents were housewives in 1967: 25.3 percent (54.9 percent were women) in contrast to 13.3 percent of the returnees when they left Israel (50.0 percent were women) (chi square .001). More women who remained became full time mothers and wives.

Similarly, upon arrival there was no significant difference among those studying at the university, 15.2 percent for permanent residents and 19.5 percent for returnees; yet, by 1967 only 9.5 percent of permanent residents were university students in contrast to 16.3 percent of the returnees before leaving Israel (chi square .02). The student who remains does in time become part of the labor force.

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[2] Among permanent residents, religiously oriented in Israel include 87 traditionalists (masorti), 30 keepers of commandments (shomer mitzvot), 138 observant (dati); nonreligious derive from 27 against observance (anti dati), 80 not observant (lo dati), 55 secularists (chiloni), 24 who wrote "don't know," and two Hebrew-Christians.

Among returnees, religiously oriented in Israel include 25 traditionalists, 66 keepers of commandments, 19 observant; nonreligious in Israel derive from 42 against observance, 12 not observant, 62 secularists, 30 "don't know."

Question 6 is affirmed. More permanent residents felt living quarters and working conditions in Israel (see Table 2) were more satisfactory than did returnees. Among permanent residents 89.5 percent reported living accommodations adequate; 78.6 percent of the returnees agreed (chi square .001). Permanent residents' more positive view of housing was reflected in two related issues. More permanent residents lived in houses, 28.4 percent, in comparison to 17.7 percent of returnees (chi square .01). Also, more permanent residents owned their living quarters, 76.7 percent, compared to 24.0 percent of the returnees (chi square .001).

Prior to departure of returnees there was no significant difference among

TABLE 2
ISRAEL COMPARED TO AMERICA

	Percentages	
Question	Returnees in America (*N*-256)	Permanent residents in Israel (*N*-443)
Opportunities in field	(*N*-224)	(*N*-327)**
less	58.5	45.9
same	25.4	30.9
more	16.1	23.2
Income for work	(*N*-218)	(*N*-314)****
less	92.7	80.6
same	4.6	10.8
more	2.8	8.6
Satisfaction in work	(*N*-194)	(*N*-346)*
less	17.0	19.4
same	45.4	33.8
more	37.6	46.8
Prestige in work	(*N*-199)	(*N*-327)*
less	24.1	27.8
same	44.2	33.3
more	31.7	38.8
Standard of living	(*N*-232)	(*N*-387)***
less	83.2	72.4
same	13.8	21.2
more	3.0	6.5
Unemployment in my field	(*N*-145)	(*N*-205)
less	29.0	24.4
same	49.0	50.7
more	22.1	24.9

* Chi square significant difference = .05.
** Chi square significant difference = .02.
*** Chi square significant difference = .01.
**** Chi square significant difference = .001.

those living on a kibbutz: 23.3 percent for returnees, 19.0 percent for permanent residents. The number living on the kibbutz had dropped from time of arrival, since the kibbutz ulpan is especially attractive to newcomers who work for room and board while learning Hebrew. However, more returnees were initially attracted by kibbutz life (see Table 1). A larger percentage of returnees did live on a kibbutz after arrival, 46.8 percent, compared to 38.3 percent of permanent residents (chi square .05).

There was no significant difference between permanent residents and returnees concerning urban and rural dwelling: 78.8 percent of permanent residents and 76.5 percent of returnees lived in urban areas; 21.2 percent of permanent residents and 23.5 percent of returnees were rural dwellers in Israel.

D. Discussion

Tensions caused by cognitive dissonance generally lead to modification of views as individuals strive to reduce inner conflict. Dissonance can also be reduced by modification of action. Subjects of this study acted by changing their country of residence, in this case leaving America to live in Israel. Such action resulted from ethnic identification which caused these American Jews to want residence in the Jewish homeland far away from disturbing problems experienced in the lands of their birth—Canada and the United States.

After arriving in Israel the process was reversed, for subjects also identified with America and its economic system. Those who remained (permanent residents) in Israel saw less difference between the economic conditions that obtain in Israel and those in America. The others (returnees), more cognizant of the differences, returned to America, where once again they are troubled by tension resulting from ethnic identification.

In retrospect, before leaving America there was among immigrants similar attraction to Israel (see Table 1). They shared the same keen desire to live in a Jewish homeland, to enjoy the opportunity of living a committed life, surrounded by fellow Jews in the land of the Bible. They balanced differences of views concerning Jewish education and kibbutz life.

More returnees arrived in Israel at a younger age knowing that those who do not stay are better off returning to America with youthful resilience. Those who became permanent residents were more convinced that they would somehow manage on their Israeli income, yet they were more inclined to make sure by spending extra time in America accumulating that nest egg. More of those with negative expectations who anticipated and found it difficult to manage on their Israeli income, were returnees.

Americans invariably match any country in which they visit or live against the economic standard of America. For Americans living in other lands the expressed economic difference produces dissonance. Permanent residents felt less economic dissonance in Israel; for returnees economic dissonance was stronger, causing them to return to America (see Table 2).

Economic dissonance is similar among those who stay, though more are religiously oriented and fewer are nonreligious in Israel (9); while returnees, of whom more were nonreligious and fewer were religiously oriented in Israel, experienced greater economic dissonance. (See Table 2).

Defense mechanisms minimized economic dissonance (6) among those who remained. Traditionalists in exile have always made economic sacrifices to live according to Jewish law (14). However, permanent residents, both traditionalists and secularists, share the feeling that as Jews they can only live in Israel. To avoid being drawn back to America they rationalize, minimizing the economic differences between Israel and America. The opposite is true for those who return to America. Since the feeling that Israel is essential for personal fulfillment is stronger among the most traditional, more were found among permanent residents than among returnees.

In addition to the defensive effect of ethnic commitment in the perception of economic differences between Israel and America, there also was an economic causal effect. More professionals were found among returnees. Israel's socialist economy favored individuals in the lower economic brackets (1). In comparison to America, the professional did not fare as well as the Israeli in the lower middle and middle middle classes (7).

Another economic causal effect relates to kibbutz living. Returnees included more disappointed kibbutzniks. Returnees more than permanent residents had been attracted to a unique social institution and found it wanting.

Reduction of the economic gap by further industrial development in Israel will reduce economic dissonance among newcomers and should insure the retention of more American immigrants in Israel unless other forms of dissonance become dominant in a society surrounded by hostile neighbors.

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STUDENT POLITICAL ACTIVITY IN RELATION TO PERSONAL AND SOCIAL ADJUSTMENT*[1]

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A. INTRODUCTION

Recent investigations of student political behavior in the United States have produced findings at variance with the popularly held notion linking student activism with maladjustment (2, 4, 5). These studies suggest no greater maladjustment for activists than nonactivists, with the former group, in fact, being somewhat more favorably endowed with positive, adaptive traits, such as intelligence. The aim of the present study was to assess the generality of these findings, focusing upon student political activity in relation to psychopathology, attitudes of social rejection, dogmatism, critical thinking ability, and political ideology.

B. METHOD

*S*s were 61 volunteers from a class of 115 students in the undergraduate course on abnormal psychology at Fresno State College. The sample consisted of 31 males and 30 females.

The following measures were administered: the Political Activity Survey (PAS), a questionnaire constructed by the authors to assess political activity *vs.* passivity, Kirtley's (6) adaptation of the Bogardus Social-distance Scale (BSD), to measure attitudes of social rejection *vs.* acceptance, the Troldahl-Powell (9) 20-item, short-form Dogmatism (D) Scale, an abbreviated version of Rokeach's (8) D Scale, Form E, Form YM of the Watson-Glaser (10) Critical Thinking Appraisal (CTA), to assess critical thinking ability, Form 60 of the Politico-economic Conservatism Scale (PEC) of Adorno *et al.* (1), to determine degree of liberal *vs.* conservative ideology, and the MMPI, which served as the measure of psychopathology.

Scored on the MMPI were the nine clinical scales, the F, K, and L scales, the Es (Ego Strength) Scale of Barron (3), and the Dy (Dependency) Scale of Navran (7).

On the PEC, the contents of Items 9 and 15 were altered in the direction of contemporary political meaning. In the original Form 60, Item 9 read

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"Most controls over business should be continued after the war." The phrase "after the war" was eliminated. The original Item 15 read "If America had more men like Henry Wallace in office, we would get along much better." The name "Edward Kennedy" was substituted for "Henry Wallace."

The BSD contained eight 10-item subscales dealing with groups in the following categories: the arts, the sciences, the political left, the political right, the physically handicapped, ethnic minorities, businesses and professions, service organizations and lodges.

The PAS consisted of 10 items covering a variety of political activities, such as production or distribution of political propaganda, involvement in demonstrations, and office holding or membership in political organizations. For each activity, *S* was instructed to rate his degree of participation along a five-point scale. In a pilot study, the PAS was found to be effective in differentiating students who were members of campus political organizations from those not so affiliated. (A copy of the complete questionnaire can be obtained from the authors.)

C. Results and Discussion

Data were analyzed by means of the Pearson product-moment method, and of the 25 correlations, thus obtained, eight were significant. With 25 correlations, only one significant relationship would be expected through chance.

Table 1 shows a significant negative correlation between the PAS and the Dy Scale of the MMPI, but all other PAS-MMPI correlations are insignificant. With respect to the BSD, Table 1 indicates significant negative correlations between the PAS and the Art (A), Science (S), Political Left (PL), and Ethnic Minority (EM) subscales, and no relationships between the PAS and the subscales for Businesses and Professions (BP), Service Or-

TABLE 1

CORRELATIONS OF POLITICAL ACTIVITY WITH MMPI, BSD, PEC, CTA, AND D SCALES

MMPI		BSD		PEC	CTA	D
Hs	.06	A	—.34**	—.31*	.32**	—.29*
D	—.12	S	—.28*			
Mf	—.04	PL	—.41**			
Pt	—.13	PR	.05			
Ma	.09	PH	—.20			
Es	.19	EM	—.27*			
L	.01	BP	.04			
Hy	.19	SL	.10			
Pd	.06					
Pf	.14					
Sc	—.17					
Dy	—.47**					
K	.18					
F	.08					

* With N of 61 and r of .26, $p < .05$.
** With N of 61 and r of .32, $p < .01$.

ganizations and Lodges (SL), the Political Right (PR), and the Physically Handicapped (PH). The D and PEC scales, as shown in Table 1, are significantly correlated with the PAS, both in the negative direction, while the PAS and the CTA show a significant positive correlation.

For this sample, then, political activity was associated with liberalism, relative freedom from dogmatic attitudes, low dependency, high critical thinking ability, and tolerant, accepting social attitudes.

The results regarding adjustment, ideology, and critical thinking ability were congruent with those of Kerpelman (5), who found no relationship between activism and a measure of ego defensiveness, although his activist *S*s were more intelligent and liberal than nonactivists.

In the mass media, student activism is often linked to dogmatic personality structure. However, Barker (2) found student activists to be no more dogmatic than nonactivists, while in the present study, activity was associated wih a lowering in dogmatism. The more active students were also more inclined to be liberal, as were Barker's less dogmatic *S*s.

In conclusion, the common public stereotype of the student activist as an over-aggressive, closed-minded neurotic does not seem to apply to most politically involved students. Quite to the contrary, in the present study this negative image appeared to be more appropriate in the case of politically passive students.

D. SUMMARY

The present study explored relationships between student political activity and a number of personality and attitudinal variables. Sixty-one undergraduate psychology students were administered a political-activity questionnaire, an adaptation of the Bogardus Social-distance Scale, the California Politico-economic Conservatism Scale, the Watson-Glaser Critical Thinking Appraisal, a short-form Dogmatism Scale, and the MMPI.

Although significant correlations were not obtained for most variables, political activity was found to be associated with emotional independence, liberalism, openness of belief system, tolerant social attitudes, and high critical thinking ability. It was concluded that the public stereotype linking student activism with negative character traits was, in general, much less applicable to politically active than to politically passive students.

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STIMULUS GENERALIZATION FOLLOWING MULTIDIMENSIONAL STIMULUS TRAINING *VS.* UNIDIMENSIONAL STIMULUS TRAINING*

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A. INTRODUCTION

Multidimensional stimulus generalization usually follows multidimensional stimulus conditioning. Few studies have attempted multidimensional stimulus generalization following unidimensional stimulus conditioning and compared it to that following multidimensional stimulus conditioning. Thus, if following training to the multidimensional stimulus XY, generalization testing to ΔXY, XΔY, and ΔXΔY is performed, generalization to the same test stimuli can be performed following training to the single dimension X.

The nature of multidimensional stimulus generalization (following multidimensional stimulus conditioning) is predicted by the formulae of three hypotheses: The excitation, discrimination, and dominance models (1, 2, 3, 5). The first two models predict a decrement in response from XY to XΔY, ΔXY and ΔXΔY. The dominance model does not predict a decrement under every circumstance; but if, for example, it predicts no decrement from XY to ΔXY, it does predict a decrement from XY to XΔY (implying in this case that Y is the "dominant" dimension). The three models do not make a prediction concerning unidimensional stimulus conditioning, however, conventional learning theories would predict that following unidimensional stimulus conditioning to only X, no decrement in response from X to XY or to XΔY would occur. Such a decrement would imply stimulus control by Y (control by the absence of Y) and thus it would not be an example of unidimensional stimulus conditioning.

It was the purpose of this study to compare the generalization slopes of unidimensional and multidimensional stimulus training. It was anticipated that multidimensional stimulus training results in stimulus control by one or more dimensions, whereas unidimensional stimulus training results in stimulus control only by the dimension on which training is given.

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B. METHOD

1. *Subjects*

The subjects were 45 male and female college graduates, ages 21-35.

2. *Apparatus*

The apparatus was similar to that employed by Purtle and Newman (4). A 2-lb. coffee can with both ends removed was secured to a heavy frame. At one end, the subject could insert his hand, at the other end the tactile stimuli could be presented. The two stimulus dimensions employed were angular orientation of a rectangular aperture and tactile texture of sandpaper. The multidimensional stimulus was a sandpaper disk (grit No. 120) placed behind a ½ × 4 inch aperture in the plastic coffee can lid and tilted at 45°. The single stimulus was either a sandpaper disk (5 inch diameter) placed at one end of the coffee can (without the aperture) or a ½ × 4 inch aperture (without sandpaper behind it). During generalization testing any one of five sandpaper textures could be used (texture A was grit No. 50; texture B, grit No. 80; texture C, grit No. 120; texture D, grit No. 220; and texture E, grit No. 320). The plastic lid could be rotated to provide any one of five angular orientations: 8°, 25°, 45°, 63°, and 72°. Previous experimentation by Purtle and Newman (4) indicated that these angles, combined with the sandpaper textures mentioned, provides a psychophysical equivalence of scale.

3. *Procedure*

Fifteen subjects (males and females randomly assigned) comprised one of three training groups: Texture and angular training (TA); texture training (T); and angle training (A). A sandpaper disk (texture C) placed behind the slit at an angle of 45° was the training stimulus for group TA. Subjects were blindfolded and instructed to insert their hand into the circular opening and "remember the stimulus." Subjects then received three blocks of 25 randomized test trials (five textures at five angles) with the same training procedure interspersed between each block of trials. A two-minute rest pause was employed between each test block. Subjects were instructed to indicate whether or not each of the test stimuli was identical to the training stimulus by saying "yes" or "no." No mention was made of the dimensions of angularity or texture.

A sandpaper disk (texture C) was the training stimulus for group T. While the subject's hand rested at the end of the can, the disk was placed against the end of the coffee can, and the subject was instructed to "remember the stimulus." An aperture angle of 45° was the training stimulus for the third group—A. While the subject's hand rested on the back wall of the can, the angle was altered until 45° was reached at which time the subject was instructed to "remember the stimulus." Generalization testing for groups T and A was identical to that of group TA.

C. RESULTS

In Figure 1 the mean number of responses per subject (mean response rate) for each of the three groups (T, A, and TA) to each of the five angular orientations and to each of the five textures is plotted. Within the texture dimension (left panel) groups T and TA showed a steep gradient in contrast to the almost flat gradient of group A. An analysis of variance revealed a significant difference between the total response rates of the three groups, $F(2,42) = 5.33$, $p <.01$. Group TA gave fewer responses, $F(1,43) = 4.22$ $p <.05$, than groups T and A which were not significantly different from each other, $F(1,28) = 1.12$, $p > .05$. The group × texture interaction was also significant, $F(8,148) = 3.71$, $p < .005$. A separate analysis of groups T and TA revealed no significant interaction, $F(4,112) = 1.05$, $p > .05$; but in comparing the combined results of T and TA to that of group A, a significant interaction was found, $F(4,172) = 3.96$, $p < .005$. Thus, the gradients of groups T and TA were significantly steeper than that of group A. A separate analysis of group A revealed no significant texture effect, $F(4,14) = .34$, $p >$ 05. This suggests no stimulus control by the texture dimension for group A.

Within the angle dimension (right panel) the gradient of group A appeared steeper than that of group TA which in turn appeared steeper than the almost flat gradient of group T. The group × angle interaction was significant, $F(8, 148) = 2.77$, $p < .01$. Separate analysis of groups T and A revealed a significant interaction, $F(4,112) = 3.98$, $p < .01$. There was also a significant interaction when comparing groups TA and A, $F(4,112) = 3.82$, $p < .01$, and when comparing groups TA and T, $F(4,112) = 3.70$, $p < .01$. Thus, the angle gradient of group A was significantly steeper than that of group TA which in turn was significantly steeper than that of group T. A separate analysis of group T revealed no significant angle effect, $F(4,14) = .73$, $p > .05$ (implying no stimulus control by that dimension) but a significant angle effect for group TA, $F(4,14) = 9.31$, $p < .01$.

Although Figure 1 accurately illustrates the generalization gradient of each group to each of the dimensions, it masks the absolute generalization of each group to changes in one of the dimensions as the other dimension is kept constant. Therefore the mean responses per subject (over all three blocks of

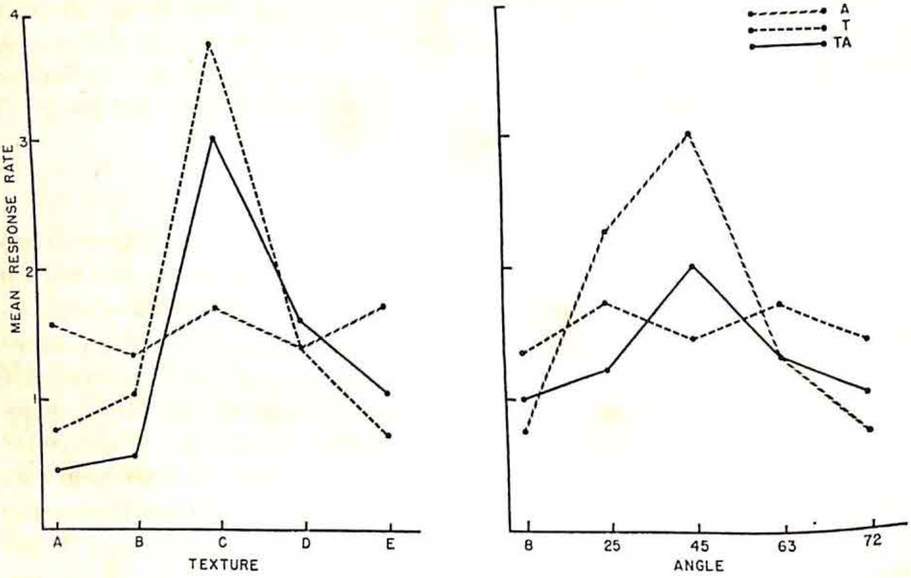

FIGURE 1
MEAN NUMBER OF RESPONSES PER SUBJECT (MEAN RESPONSE RATE) FOR EACH OF THE THREE GROUPS TO EACH OF THE FIVE TEXTURES (LEFT PANEL) AND TO EACH OF THE FIVE ANGULAR ORIENTATIONS (RIGHT PANEL)

trials) to changes in one dimension only is plotted in Figure 2. In the left panel, the gradients to changes in texture, at an angular orientation of 45°, are plotted for each group. They are comparable to the gradients of Figure 1 (left panel) except now the absolute generalization of group A is more evident. Statistical analysis revealed similar interaction effects to that seen in Figure 1 (left panel). However, total responding of group A was significantly greater than that of groups TA and T, $F(1,43) = 8.90$, $p < .005$, which were not significantly different from each other, $F(1,28) = 1.42$, $p > .05$. In the right panel the gradients to changes in angular orientations, at the C texture, are plotted for each group. These gradients are comparable to those in Figure 1 (right panel) except now the large absolute generalization of group T to changes in angular orientation is evident. Statistical analysis of the gradients revealed similar findings to those of Figure 1 (right panel) with the exception that the total responding of group T was significantly greater than that of groups TA and A, $F(1,43) = 7.39$, $p < .01$, which were not significantly different from each other, $F(1,28) = 2.85$, $p > .05$.

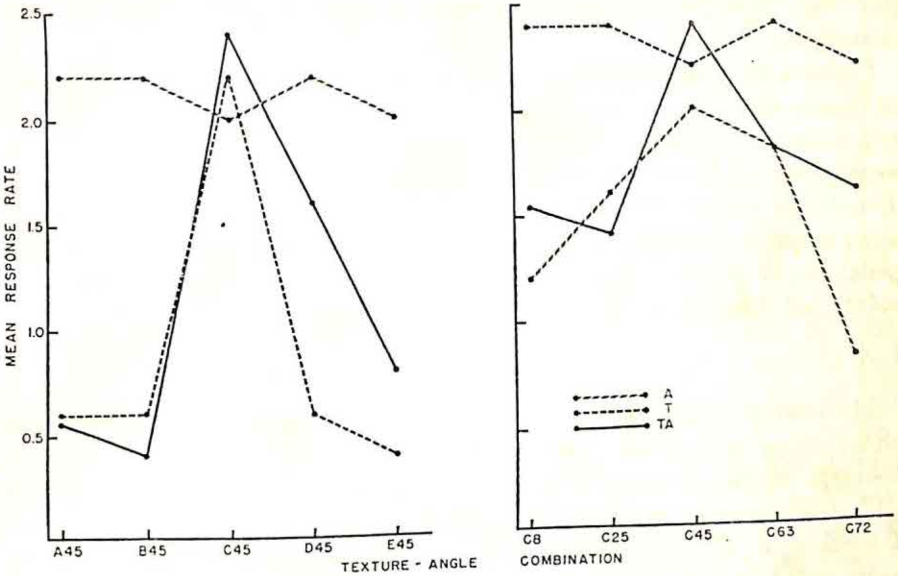

FIGURE 2

Mean Number of Responses per Subject (to all Three Blocks of Trials) for Each of the Three Groups to Each of the Five Textures when the Angle is Constant at 45° (Left Panel) and to Each of the Five Angles when the Texture is Constant at C (Right Panel)

D. Discussion

The results indicate that nondifferential training to a two-dimensional stimulus can result in stimulus control by both dimensions. However, stimulus control by each dimension is slightly weaker than if unidimensional training to that dimension is given. Perhaps this is due to divergence of attention from one dimension to the other during multidimensional stimulus training.

A determination of the predictive value of the three models for the TA group was not made becaue it is irrelevant for the purposes of this study. However, it is obvious that the dominance model cannot apply since stimulus control was obtained by both dimensions. These results seem to conflict in part with those of Purtle and Newman (4) who used an almost identical training procedure and found that the dominance model best predicts the results. But since they also demonstrated that the predictive value of a model depends on the training procedure, the slightly different training procedure used in this experiment could account for the difference in predictive values of the models.

Moreover, their data do show a tendency toward stimulus control by both dimensions.

Training to a unidimensional stimulus resulted in stimulus control by one dimension only—the one on which training was given. Consequently, absolute generalization to changes in the nontrained dimension was greater than the generalization following multidimensional stimulus training. The three models of multidimensional stimulus generalization were not intended for unidimensional stimulus training. However, if they were applied, only the dominance model would be appropriate since in generalization testing only one dimension maintained stimulus control.

E. SUMMARY

Multidimensional stimulus generalization following multidimensional stimulus training was compared to that following unidimensional stimulus training in human subjects. The training procedures were training to a tactile dimension (T), training to an angular orientation dimension (A), and training to both dimensions (TA). Generalization testing for all groups consisted of three sequences of 25 test stimuli (five textures paired in all combinations with five angular orientations). Training to both dimensions resulted in stimulus control by both dimensions. Training to one dimension resulted in stimulus control by one dimension only—the one on which training was given.

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DISCRIMINATION, GENERALIZATION, AND AWARENESS IN VERBAL OPERANT CONDITIONING*

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A. INTRODUCTION

Several studies have indicated that generalization of a conditioned response (CR) in unaware subjects is not demonstrable or is less than the generalization found in aware subjects (4, 5, 7, 10). Moreover, it has been suggested that generalization and awareness are unrelated (11). This reasoning has a strong basis: (*a*) it is generally agreed that learning with awareness is greater than learning without awareness, and (*b*) with an increase in the strength of learning there is a concomitant increase in the strength of generalization. Thus, it should not be surprising that aware subjects demonstrate greater generalization than unaware subjects, however, several studies have found greater generalization in unaware subjects (6, 8). This discrepancy has yet to be resolved. One of the reasons given to account for the greater generalization in unaware subjects is that the aware subject places verbal labels on the stimuli, thereby discriminates the stimuli better, and therefore generalizes less. However, in verbal operant conditioning (VOC) the stimuli are words and are not likely to be given verbal labels. Therefore, stimulus labeling alone cannot account for the results and another explanation must be sought.

If discrimination learning is also greater in aware subjects, it would follow that generalization should be less. Under most circumstances discrimination is the inverse of generalization, and discrimination learning is known to result in steepening of the generalization slopes (12). Thus, the results of at least some experiments which have shown greater generalization in unaware subjects may be explained. If in the course of those experiments discrimination learning occurred to the aware but not the unaware subjects, generalization would be greater for the unaware subjects. It was the purpose of this experiment to demonstrate that aware subjects discriminate better than unaware subjects and for that reason may not generalize as well either.

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B. METHOD

1. *Subjects and Apparatus*

Sixty college graduates, ages 21-35, were used. A sentence-construction task similar to that used by Taffel (9) was employed as the VOC procedure. The stimulus materials for the discrimination task consisted of 60 five by eight inch index cards. Two hostile and two neutral verbs were printed on each card. One of the hostile and one of the neutral verbs were in black; the other hostile and other neutral verb were in blue. Each verb was placed in a corner of the card. Choice of verbs was similar to that used by Buss and Durkee (2). Since there were not enough hostile verbs for 60 cards, each hostile verb was used twice, once in each color. The Thorndike-Lorge word count was used to match the frequency of the hostile and neutral verbs on any one card. The order of placement of the verbs on the cards was randomized.

2. *Procedure*

Subjects were randomly assigned to one of four reinforcement groups—hostile black, hostile blue, neutral black, or neutral blue. Each subject was told that he was about to take a test of learning ability. He was instructed to make up a sentence using one of the four verbs on each card. One hundred twenty trials were given (the cards were used twice). During trials 1-15 the experimenter said nothing; during trials 16-120 he said "right" after the correct verb was used and "wrong" after an incorrect verb was used. Thus, subjects received positive reinforcement for using the specific stimulus and negative reinforcement for using the semantically different stimulus, the color-different stimulus or the totally different stimulus; e.g., if black hostile verbs were the specific stimuli, the blue hostile verbs were the color-different stimuli, the black neutral verbs were the semantically different stimuli, and the blue neutral verbs were the totally different stimuli. Intertrial interval averaged 10-15 seconds. Following the training task, an assessment of awareness was made using a questionnaire similar to that of Thaver and Oakes (11).

C. RESULTS

The results of each reinforcement group were not significantly different (analysis of variance) and therefore were pooled for analysis. All subjects could then be subdivided into those who were aware of the specific stimulus-response contingency, those who were partially aware (aware of only the semantic component of the contingency or the color component of the contingency), and those who were unaware of either component. Twenty-six subjects

(43%) were totally aware, 18 (30%) were aware of the semantic component, five (8%) were aware of the color component, and 11 (19%) were totally unaware. In Figure 1, the mean number of responses to the specific stimuli is plotted as a function of blocks of 15 trials for each level of awareness. The greatest learning occurred in the totally aware group which was greater than that of the two partially aware groups which, in turn, was greater than that of the unaware group. Analysis of variance indicated a significant effect beyond the .01 level for both trials and awareness groups ($F = 3.42$, *df* 7/392 and $F = 4.92$, *df* 3/56, respectively). Interaction of groups and trials also approached significance ($F = 1.64$, *df* 21/392, $p < .05$). Individual analysis revealed a significant trial effect beyond the .025 level for all four awareness groups.

In Figure 2, the mean number of responses to the color-different stimuli is plotted for each level of awareness. The totally aware group showed a slight increase in responding followed by a dramatic decrease in responding. The color aware group showed a decrease in responding, and the semantically aware group showed an increase in responding above the prereinforcement

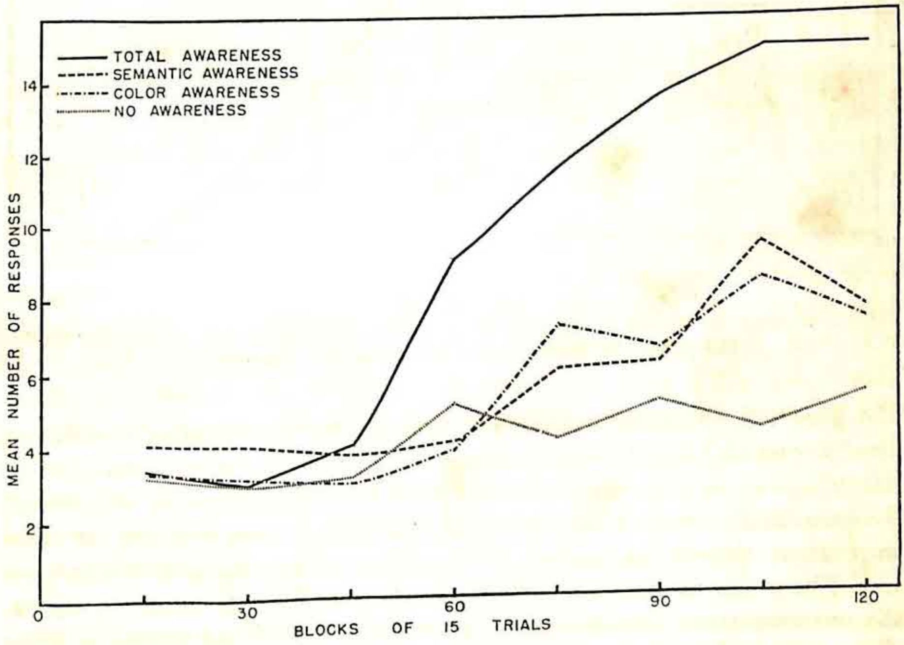

FIGURE 1
MEAN NUMBER OF RESPONSES TO THE SPECIFIC STIMULI AS A FUNCTION OF BLOCKS OF 15 TRIALS FOR EACH LEVEL OF AWARENESS

level. There was no appreciable change in the rate of responding by the totally unaware group. Analysis revealed a significant awareness effect beyond the .01 level ($F = 2.75$, df 7/392) but no significant trial effect ($F = 2.72$, df 3/56). However, interaction approached significance ($F = 1.78$, df 21/392, $p < .025$) and individual analysis indicated a significant trial effect beyond the .01 level for all groups except the unaware group.

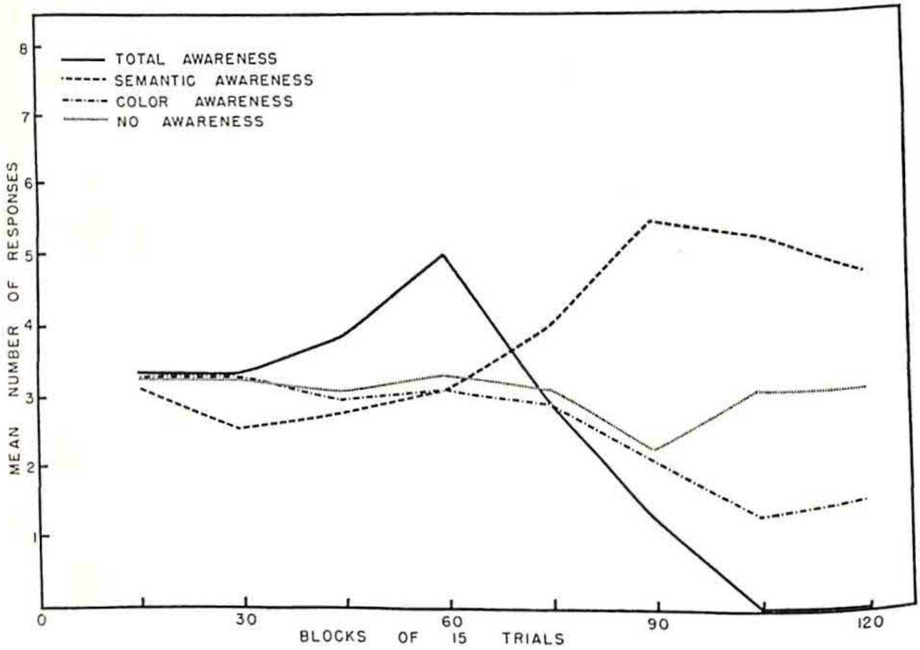

FIGURE 2
MEAN NUMBER OF RESPONSES TO THE COLOR-DIFFERENT STIMULI AS A FUNCTION OF BLOCKS OF 15 TRIALS FOR EACH LEVEL OF AWARENESS

In Figure 3, the mean number of responses to the semantically different stimuli is plotted for each level of awareness. The totally aware group showed a slight increase in responding followed by a dramatic decrease in responding. The semantically aware group showed a decrease in responding, and the color aware group showed an increase in responding above the prereinforcement level. There was no significant change in the rate of responding for the totally unaware group. Analysis revealed a significant trial and awareness effect ($F = 3.43$, df 7/392, $p < .01$ and $F = 3.41$, df 3/56, $p < .025$, respectively). Interaction approached significance ($F = 1.77$, df 21/392, $p < .025$)

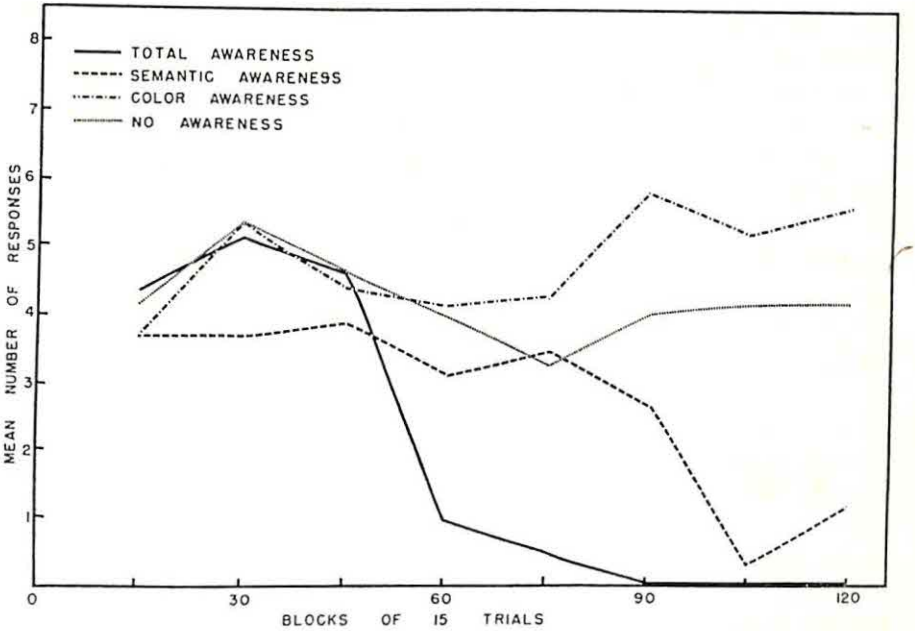

FIGURE 3
MEAN NUMBER OF RESPONSES TO THE SEMANTICALLY DIFFERENT STIMULI AS A FUNCTION OF BLOCKS OF 15 TRIALS FOR EACH LEVEL OF AWARENESS

and individual analysis indicated a significant trial effect beyond the .01 level for all groups except the unaware group.

D. DISCUSSION

The aware subjects' demonstration of perfect discrimination learning (maximum responding to the specific stimuli and minimum responding to the other three stimuli) is not surprising and is consistent with the studies previously mentioned. Of more interest are the partially aware subject. The color aware subjects responded well to the specific stimuli and to the semantically different stimuli and in effect were generalizing their learned response along a semantic dimension. Conversely, the semantically aware subjects who responded well to specific stimuli and to color-different stimuli generalized their learned response along a color dimension. No doubt if the discrimination task was permitted to continue for the partially aware subjects, they would have learned both components of the CS and would have shown excellent discrimination. In fact, if one looks closely at the learning curves of the totally aware group (Figures 2 and 3), there is a point where the number of responses to semantically different and color-different stimuli increases above the prereinforcement level but then with further trials declines as discrimination develops. If the procedure was stopped at this point the subjects would probably have been aware of only one component of the CS. Learning by the totally unaware subjects in this experiment was weak and therefore significant responding to the semantically different and color-different stimuli could not be demonstrated. With a more refined learning technique, however, it should be possible, even in totally unaware subjects, to demonstrate increased responding to color and semantically different stimuli above prereinforcement levels.

Krieckhaus and Eriksen's (5) study which utilized a two component CS similar to the one used here and the word "good" for reinforcement failed to show differences in generalization between partially aware and totally aware subjects. Perhaps this is because reinforcement with "good" does not result in as much discrimination learning as does the "right"-"wrong" type of reinforcement.

There is parallel evidence in the literature to suggest that unaware subjects do not discriminate as well, and therefore generalize more. Wickens and Harding (13) conditioned the galvanic skin response to both tone and light stimuli. Those subjects who were forewarned that only one of the stimuli would be paired with shock, showed a discriminatory response. Those who were not forewarned responded equally to both stimuli. Similarly, Baer and Fuhrer (1, 3) found that conditional differentiation of positively and negatively reinforced stimuli (CS+ and CS—) was limited to subjects who verbalized the stimulus contingencies. Although not markedly evident, unaware subjects responded to both CS+ and CS— and thus were in effect generalizing their response from CS+ to CS—.

The concept of learning and awareness here has been that awareness (in terms of the subject's ability to verbalize the stimulus response contingency) is a concomitant of learning and not a determinant; i.e., when the subject learns a component or two of the CS well enough he is then able to verbalize it. The reason partially aware subjects generalize better (or discriminate more poorly) than aware subjects is not because they are less aware but because they learned a response short of the ability to discriminate.

Not all discrimination tasks will demonstrate greater generalization by partially aware or unaware subjects. If a one component CS were used—e.g., hostile and neutral verbs of one color—partial learning short of discrimination would be difficult to demonstrate, and without some learning there can be no generalization. In order for partially aware or unaware subjects to demonstrate better generalization than totally aware subjects they must demonstrate some learning short of the ability to discriminate. This is most easily accomplished with a two component CS.

E. SUMMARY

Subjects underwent a Taffel-type verbal operant conditioning task using hostile black, hostile blue, neutral black, and neutral blue verbs. One of the four verbs (specific stimulus) was reinforced with "right," the other three (semantically different, color-different, totally different) were reinforced with "wrong." Some subjects verbalized both the color and semantic contingency (totally aware), some only the semantic or the color component of the contingency (partially aware), whereas others were unaware. Totally aware subjects discriminated perfectly; color aware subjects responded well to specific stimuli and to semantically different stimuli; semantically aware subjects responded well to specific stimuli and color different stimuli; totally unaware subjects responded well to the specific stimuli only. The results suggested that totally aware subjects discriminate better than partially aware or unaware subjects and for that reason generalize less.

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EFFECTS OF LYSERGIC ACID DIETHYLAMIDE ON THE MATERNAL BEHAVIOR OF THE RAT*[1]

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A. INTRODUCTION

Goodman *et al.* (2) reported that hamsters with hippocampal lesions were deficient in the care of their litters. Thus, it seemed that the hippocampal system participated in the organization of maternal behavior. The disruption of the hippocampal system by an injection of lysergic acid diethylamide (LSD-25), a potent hallucinogen, was demonstrated by Evarts and Marshall (1). The results of the two experiments provided the basis for the following hypothesis: An administration of LSD-25 to female rats will disrupt their maternal behavior. The present experiment on nursing behavior was conducted to test the hypothesis.

B. METHOD

Twenty-five matured female rats of the Wistar strain were mated with healthy males. At parturition, twenty females that bore ten or more offspring each were selected for the drug study. Each mother was allowed to nurse ten offspring. All other offspring were discarded. Six days after parturition, each mother and its ten offspring were housed in a test cage. Each cage (42 × 26 × 18 cm) was divided into three compartments by two partitions, one of them erected ten cm from the left end of the cage and the other located ten cm from the right end. Each partition had a doorway, allowing an animal to crawl from one compartment to the next one. One of the end compartments was considered to be a nesting place, while the other one at the opposite end was used as a confining chamber.

Nine days after parturition, the mothers were housed in the confining chambers during the night. In the morning they were given a pretest to measure their nursing behavior. The pretest was initiated by opening the partition doors and allowing the mothers to go to the nesting compartments to nurse their off-

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spring. The starting time of the test and that of the nursing, and the duration of nursing were recorded. They were allowed to nurse until they attained the criterion of 15 minutes of continuous nursing. For each mother, the time taken to attain the criterion was noted. According to their time scores, they were matched and assigned equally to experimental and control groups. Experimental mothers were injected intraperitoneally with .2 mg/kg of LSD-25, whereas the control mothers were given .9% saline solution. A standard volume of one ml/kg of LSD-25-saline solution or that of saline solution alone was injected to each experimental or control animal, respectively. Fifteen minutes after the injection they were given a nursing test. The test was begun by opening the partition doors and permitting the mothers to enter their nests and to nurse their pups. The duration of time they nursed during the three-hour test period was recorded.

C. Results And Discussion

Most of the experimental animals entered the nursing compartments, sniffed their offspring, crept into the middle compartment, prostrated quietly, and writhed occasionally. On the other hand, all of the control animals began nursing within five minutes. Some of the treated animals began to nurse approximately an hour after the initiation of the test, but they did not continuously nurse them as most of the control animals did. One and a half hours after the initiation of the test, most of the experimental animals had started to nurse. The mean nursing time (79.3 minutes) of the experimental group was significantly shorter than that (153.0 minutes) of the control group ($t = 2.88$, $df = 18$, $p = < .001$), indicating that the hypothesis was tenable. Nine days after the test, the mean weight (34.3 gm) of the offspring of the experimental mothers was not significantly different from that (35.6 gm) of the offspring of the control mothers, indicating that the temporary disruption of nursing had no significant effect on the growth of the offspring.

The results, showing that the administration of LSD-25 prevented temporarily an ongoing nursing response, are consistent with those of the author's previous studies indicating that LSD-25 interrupted the orientation response of the rat in the underwater swim alley (5), inhibited the social dominance behavior in a food competition situation (4), and disrupted the visual size discrimination performance of the squirrel monkey tested in the Wisconsin General Test Apparatus(6).

D. Summary

Nine days after parturition, 20 female rats of the Wistar strain were matched according to their nursing behavior and assigned to an experimental and a control group. The experimental animals were injected intraperitoneally with .2 mg/kg of lysergic acid diethylamide, while the control animals were given .9% saline solution. Fifteen minutes after the injection, they were administered a nursing test and observed for three hours. Most of the experimental animals did not start nursing until 1½ hours after the initiation of the test, whereas all of the control animals began nursing within five minutes. The mean nursing time of the experimental group was significantly shorter than that of the control group, indicating that the administration of hallucinogenic compound disrupted the maternal behavior.

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NEWS NOTE

Under this heading appear selected items that are considered to be of interest to psychologists.

The American Psychiatric Association invites applications for its annual Hofheimer Prize Award ($1500) for outstanding research in psychiatry and mental hygiene. Applicants must be U.S. or Canadian citizens, not older than age 50. If a group of co-workers is involved, their median age must be less than 50, and the majority of them must be U.S. or Canadian citizens. Any professional person who has done creative work in this area is eligible. However, the work must have been completed or published within the last three years or on or after July 1, 1967. To apply, submit six copies of the book or research report, or six reprints of publications that report it, to Robert A. Cohen, M.D., Chairman, Hofheimer Prize Board, American Psychiatric Association, 1700 18th Street N.W., Washington, D.C. 20009. Books, reprints, or other entries will be acknowledged, but will not be returned. The deadline for submission is January 31, 1971, and any entry to be considered must be in Washington by that date.